Speed-up TOOLS and EQUIPMENT

for

Maintenance · Production · Construction

HANDBOOK

No. 143 A

MOTOR MAINTENANCE EQUIPMENT
INDUSTRIAL ELECTRICAL EQUIPMENT
VARIABLE SPEED TRANSMISSIONS
MACHINE TOOL ACCESSORIES
WIRING DEVICES and TOOLS

IDEAL Sycamore

IDEAL COMMUTATOR DRESSER CO. - SYCAMORE, ILLINOIS

BRANCHES IN: NEW YORK - PITTSBURGH - DETROIT - CHICAGO

IDEAL *Sycamore*

"Quality Equipment to Meet the Individual Need"

OUR POLICY FOR 28 YEARS

To sell only quality tools and equipment made to the best engineering specifications and highest manufacturing standards.

To constantly develop and create new tools and equipment —both through laboratory research, and contact with our users.

To sell without high pressure salesmanship or substitution.

To select Sales Representatives who are capable of giving a service which is valuable in improving maintenance, speeding up production, and keeping costs down.

Our business is based on the proposition that IDEAL Products *must not be* an expense to the purchaser, but an investment which pays large dividends over a long period of years.

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IDEAL COMMUTATOR DRESSER CO.
Sycamore, Illinois, U.S.A.
Phones: 77, 700 and 779

BRANCH OFFICES

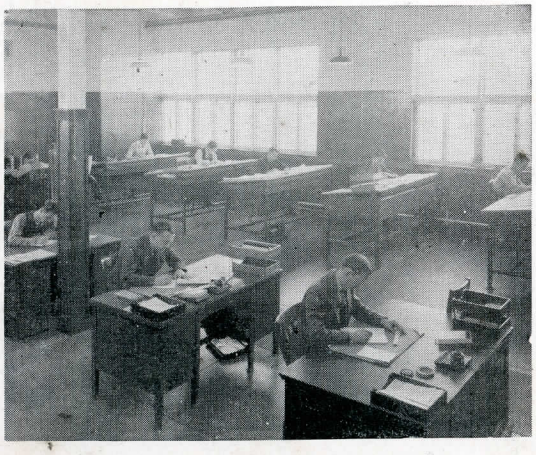
NEW YORK
61 East 11th Street
Gramercy 5-2390 and 5-2391

PITTSBURGH
Fulton Bldg.
Atlantic 8338

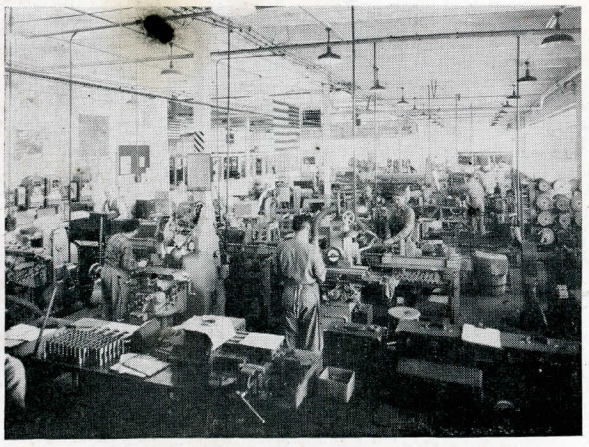
DETROIT
6432 Cass Ave.
Madison 6300

CHICAGO
600 W. Jackson Blvd.
Monroe 6970 and 6971

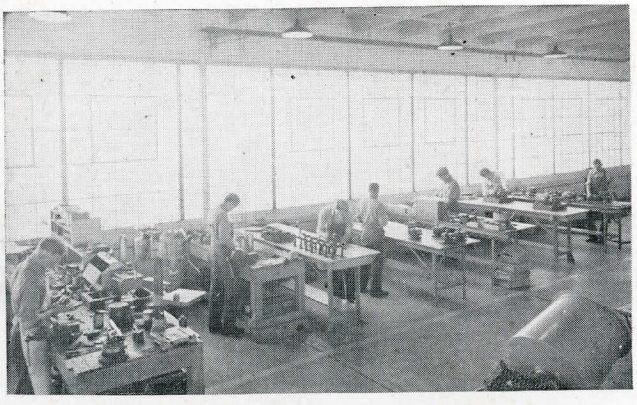
FOREWORD



ENGINEERING DEPARTMENT—the birth place of new IDEAL Products. This large well lighted room was especially planned for the constantly growing Engineering Staff.



MACHINE SHOP—always clean and tidy. Full glass windows on three sides and skylights above help to make working conditions most satisfactory.



TEST DEPARTMENT—all IDEAL Products are carefully inspected and tested before they are placed in stock for shipment. Just another step to insure customer satisfaction.

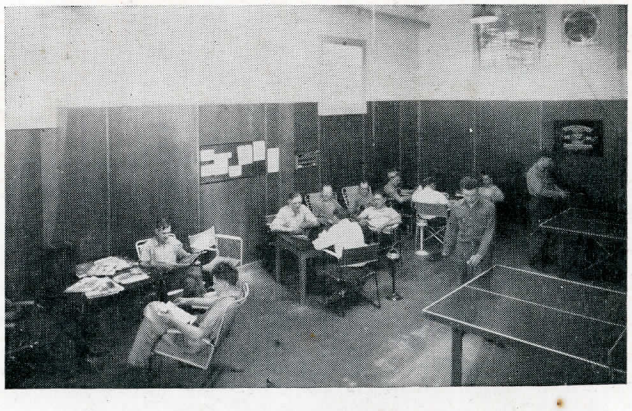
FOR over a quarter of a century, the IDEAL COMMUTATOR DRESSER COMPANY has manufactured quality industrial equipment—for use in general plant maintenance, production, manufacturing and construction. Commutator and Slip Ring Resurfacers—the first product—millions sold—enjoy a constant repeat business which gives conclusive proof of the quality of IDEAL Products and their cost saving features.

Since 1916, IDEAL has engineered important developments and improvements for use in all industry—always with the thought of lessening the grief and drudgery of the workman, increasing efficiency of electrical machinery, speeding up production, and lowering costs. IDEAL Products are the recognized *standard* in thousands of plants, because they save money, save time and above all, eliminate lengthy shut-downs which is an important factor in any plant.

IDEAL Products are constantly developed and improved through research and through closest possible contact with the advanced needs and desires of the men who use them.

Local representatives are available in all parts of the country. These men sell a cost-reducing service and make recommendations for the purchase of IDEAL Equipment only when they know economies effected will more than offset the purchase price. A stock is maintained in almost all principal cities, assuring prompt deliveries.

Serving Over 40,000 Users



RECREATION ROOM—leisure hours are enjoyably whiled away . . . reading, playing table tennis, checkers, and cards. Happy congenial workers, insure quality workmanship.

See Hints and Tables, Pages 71 to 88

MODERN MAINTENANCE METHODS

Keep Motors And Generators Operating At Peak Efficiency

No Shut-Downs— No Dismantling Necessary!

Experience has proven that the best way to maintain electrical equipment is to inspect it periodically and immediately correct any trouble that may have developed. Minor faults can usually be corrected at such a time at minimum expense and without delaying production.

Periodic maintenance greatly lengthens the time between major overhauling jobs and lengthens the useful machine life.

Preventative care is particularly important with the sliding brush contacts of electrical rotating equipment; ie. commutators and brushes, slip rings and brushes. If minor troubles such as ridges, burns, flat spots and high mica are not eliminated, they tend to become more serious and may necessitate a complete shut-down with expensive repairs.

Hand Resurfacing

The best and least expensive way to remove pin ridges, roughness and small flat spots from commutators and slip rings is with an IDEAL Resurfacer of the proper size and grade. The Resurfacer is used by firmly pressing it against the commutator or ring and slowly moving it from side to side while the motor or generator is turning at full speed. (See pages 4 to 8 for IDEAL Resurfacers.)

Grinding

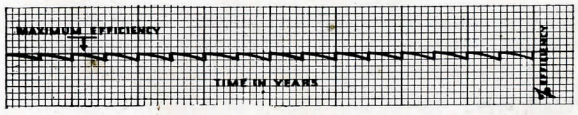
If the commutator or slip ring is badly grooved, scored, or out of round, it can easily be made like new again with an IDEAL Precision Grinder and Tool Type Resurfacers. The Grinder mounts right on the motor frame or brush holder and grinding is done with the machine running at normal operating speeds. No dismantling is necessary—no production delays. (See pages 10 to 12 for IDEAL Precision Grinders.)

Undercutting Mica

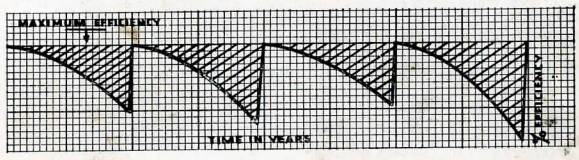
Sparking caused by high commutator mica is eliminated by undercutting the mica with an IDEAL Mica Undercutter. Undercutting permits the use of modern non-abrasive brushes assuring maximum commutator efficiency. Either "V" or "U" slots may be cut as desired. (See pages 13 to 15 for IDEAL Undercutters.)

Regular care of the commutator or slip ring by resurfacing, grinding, or undercutting (commutator only) keeps electrical equipment at highest efficiency and in constant service. It more than pays for itself by eliminating production delays and costly repair bills.

GOOD COMMUTATION IS GOOD INSURANCE!



Periodical maintenance with Ideal Motor Maintenance Tools keeps machines operating close to maximum efficiency.



Motors not given periodic maintenance lose efficiency more rapidly as time goes on and finally after a few years must be taken out of service for a major overhauling job. The cross hatched part in the diagram above visualizes this loss in efficiency.

ANSWERS

To Commutator, Ring and Brush Problems

Excessive Commutator Film?

Apply IDEAL Commutator Cleaning Stone to remove all the excessive film and dirt.

Excessive Deposits of Brush Materials?

First wipe off any oil with rag, then use IDEAL Commutator Cleaning Stone.

Grooves, Ridges, Pits, Burns?

Periodic use of IDEAL Commutator or Slip Ring Resurfacers will help to maintain a smooth polished surface.

Bad Scores, Out-of-Round?

Resurface commutator or slip ring, using an IDEAL Precision Grinder. Prevent recurrence by periodic use of IDEAL Resurfacers.

High Mica?

Resurface commutator with IDEAL Hand Type Resurfacer of *Medium* or *Finish* Grade, or undercut mica with IDEAL Undercutter.

Seating Brushes?

Do the job right with an IDEAL Brush Seater. Quickly—accurately seats each brush under actual operating conditions.

SEE PAGES 71 to 88 FOR OTHER COMMUTATOR TROUBLES AND REMEDIES.

RESURFACERS

Patented—No. 1,660,316

Uniform Quality For 28 Years!

IDEAL Resurfacers are artificial abrasives especially developed for hand or machine mounted grinding of commutators and rings. They have been developed through many years of close study of commutator and ring maintenance problems. Their patented process of manufacture and close scientific control produce the *most uniform,* fastest, free cutting, slowest wearing, non-copper collecting, non-conducting Resurfacers obtainable. Uniformly consistant results make them unequaled for maintenance service.

The "Original" Resurfacer

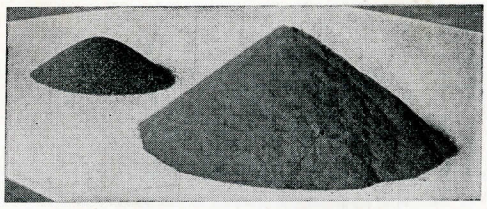
IDEAL'S were the first manufactured commutator Resurfacers placed on the market — over 28 years ago. They met a need which had existed for years for a Resurfacer of the right composition and absolute uniformity; a Resurfacer which could be furnished in definite specific grades from roughing to finishing, and with a method of manufacture so finely controlled that each grade would be exactly the same—in one Resurfacer or in millions. No natural stone has been found or ever will be found that meets these requirements.

The grindings removed by IDEAL Resurfacers consist of 85% to 75% copper and only 15% to 25% of Resurfacer grain, showing that it cuts down copper six or seven times as fast as it wears itself away. Many accurate tests have proven this fact.

This efficiency together with the excellence and smoothness of commutator finish which is attained has never been surpassed by use of any other product or device.

Method Of Manufacture

IDEAL Resurfacers are made by the "hot mix" process which permits close control of temperatures and other conditions of manufacture. Only new abrasives of the best grade, and sharpest, hardest materials are used. There is absolutely no metal in the grain to impair dielectric properties.



Efficiency Test. The large amount of commutator copper (right) was removed while the Resurfacer lost only the small amount of abrasive (left).

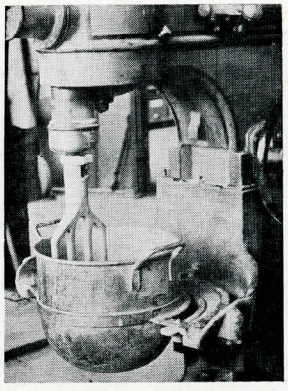
The abrasive is carefully screened so that only a given size of grain will be found in a given grade of Resurfacer. This is very vital to the continued uniformity. Then the abrasive grain is thoroughly mixed with the bonding elements. This again has a vital effect upon the cutting efficiency and particularly on the ability to make each grade *absolutely uniform.*

The final step is the baking and hardening. To be absolutely sure that every Resurfacer receives exactly the same temperature treatment throughout, they are baked in traveling ovens which keep up a continuous movement at uniform speed during the entire process. Temperature control standards or specifications are set up for each grade and type of Resurfacer and temperature conditions must be duplicated on every run of the same grade and type or it is rejected.

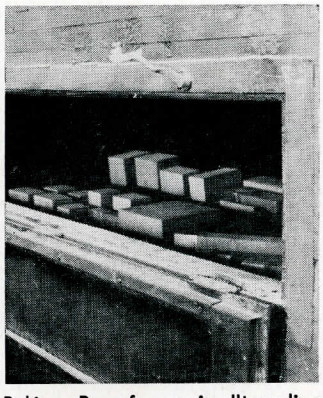
Every Resurfacer Inspected

An experienced and skilled inspector carefully examines and tests each production run. This includes the check for hardness, size of grain, uniformity of baking temperature, cutting efficiency, etc. Any Resurfacers that do not exceed the high and rigid requirements are immediately rejected.

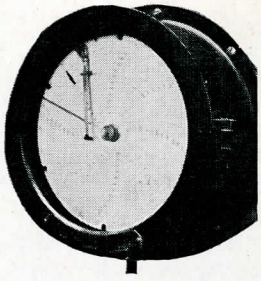
These scientific manufacturing processes and standards, which have taken years to bring to their present state of perfection, indicate why users can expect not only more service but *more uniform service* from IDEAL Resurfacers.



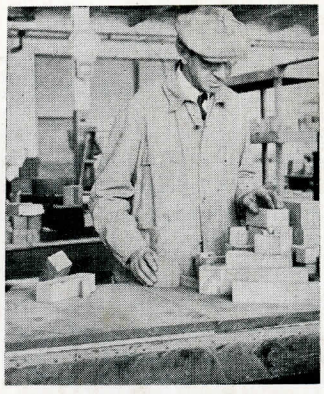
Thoroughly mixing ingredients to assure uniformity.



Baking Resurfacers in "traveling ovens" for uniform hardness.



Recording thermometers give exact record of oven temperatures



Inspection. Every IDEAL Resurfacer must meet exacting specifications.

RESURFACERS

Patented—No. 1,660,316

A Size and Type For All Conditions—For Copper—Bronze—Iron—Steel

IDEAL Resurfacers are made in five grades; "Extra Coarse," "Coarse," "Medium," "Finish" and "Polish," for commutators, and for copper or bronze slip rings. For cast iron or steel slip rings a special Resurfacer, known as the No. 81 is recommended. The No. 81 is available in three grades—"Coarse," "Medium," and "Finish."

According to accurate tests, IDEAL Resurfacers remove approximately 85% copper to 15% Resurfacer used. Freedom from clogging insures fast cutting and restoration of commutator or ring to original condition in shortest possible time. Almost any size Resurfacer is available with a wide selection of handles. To assure maximum satisfaction in service, be sure and study pages 6, 7 and 8 before ordering.

How To Use

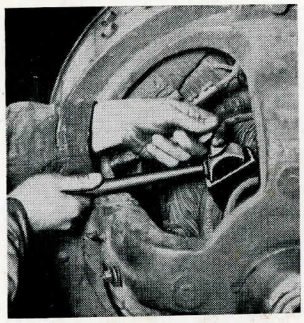
The Resurfacer should be pressed firmly against the commutator and moved slowly from side to side in direction of commutator bars. This should be done with the machine running, *no load* at full speed. Thus, centrifugal stresses are the same as in normal operation and the commutator is finished with every segment in its true operating position.

On low voltage machines, such as elevator traction motors, the resurfacing may be done with the machine running *full load*. This is possible due to the high insulating properties of IDEAL Resurfacers and their handles, and the absence of metallic particles in the grain.

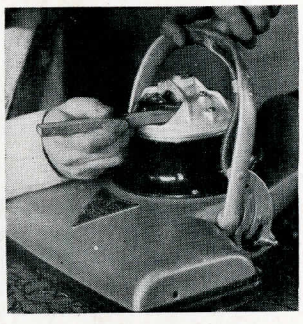
Where only a small amount of copper is to be removed, it is recommended that a "Medium" or "Finish" grade stone be used, followed by a "Polish" grade stone to give the commutator a highly burnished finish.

To remove a large amount of copper, the "Coarse" or "Extra Coarse" stone should first be used, followed by the "Medium" or "Finish" grade and then the "Polish."

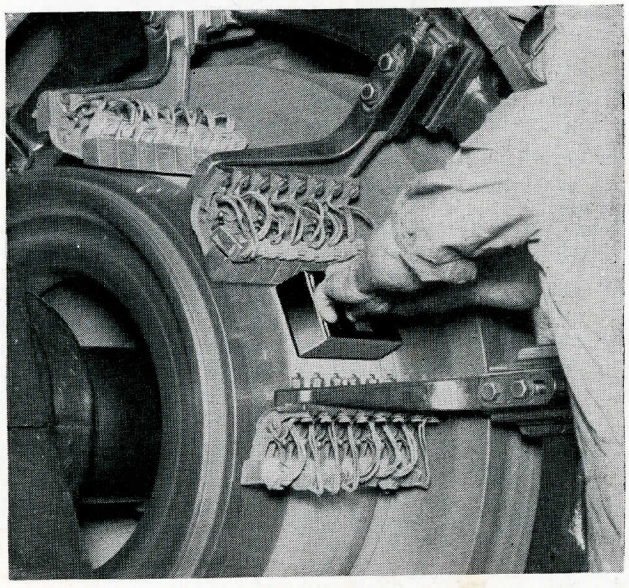
Best results are obtained after the Resurfacer has shaped itself to the commutator or slip ring. It then cuts rapidly and wears away very slowly.



Vertical Adjustable Handle Type Resurfacer being used on motor commutator.



Small "Pencil Type" Resurfacer truing commutator of small fractional horsepower motor.



IDEAL "Coarse" Grade Resurfacer gives quick cutting action on commutator of rotary converter.

When To Use

IDEAL Resurfacers may be used in two ways:

1. As a periodic maintenance tool to maintain commutators and slip rings at original efficiency, and greatly prolong the period between major overhauling.
2. For reconditioning when through accident or neglect the commutator or ring has become badly scored, ridged or burned.

When commutators or slip rings first show signs of wear or when pin ridges announce coming of deeper, more troublesome ridges; when minute sparks indicate roughness, high mica, etc.—a few minutes application of one of the finer grades of IDEAL Resurfacers will put the surfaces back into their original efficient condition, with the removal of but a hairs breadth of metal. Greatly prolongs the period between overhauling.

If commutators and rings are neglected when the early evidences of trouble develop, then a coarser grade of IDEAL Resurfacer will be required and a considerable amount of metal will have to be removed.

Flat spots, for example, require the grinding away of a considerable amount of copper, (sandpaper is not satisfactory for it simply broadens flat spots—does not remove them). To remove a flat spot 1/32″ deep, 1/32″ copper must be ground from the entire surface of the commutator before the flat spot will disappear.

That's why it is very important to use IDEAL Resurfacers periodically, and maintain high initial efficiency of commutators and slip rings *without dismantling*.

Guaranteed

IDEAL Resurfacers like other IDEAL Products are guaranteed to give complete satisfaction. They will not pick up copper, copper dust, or dust from any other metal, and always present a clean, sharp cutting face.

See Hints and Tables, Pages 71 to 88

RESURFACERS

Patented—No. 1,660,316

Five Grades for Commutators, Brass or Copper Slip Rings

EXTRA COARSE—Very fast cutting. For "hogging" off excessive copper or brass.

COARSE—Fast cutting. For use where a fair amount of copper or brass is to be removed.

MEDIUM—For general utility, high mica, small ridges and burns.

FINISH—For use after the three grades above. Brings surface to a nice velvet, which quickly becomes a gloss after the brushes have been lowered. For periodic application and for the removal of small burns and ridges immediately after their appearance.

POLISH—An exceedingly fine grade which gives a burnish finish. The "Polish" Grade is of an exceedingly fine 220 aggregate grain which accounts for the exceptionally brilliant and smooth finish it puts on commutators and brass or bronze slip rings.

Three Grades for Cast Iron and Steel Slip Rings

The No. 81 IDEAL Resurfacer is a specialized type, compounded especially for the truly effective grinding of steel and cast iron slip rings. It is a slight conductor and should be used with the current off and no load on the machine.

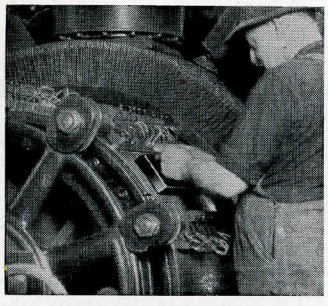
NO. 81 COARSE—For rapid grinding and for removing large quantities of material.

NO. 81 MEDIUM—For general utility and removing small pits and burns.

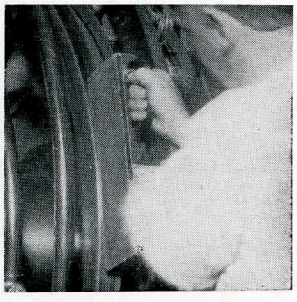
NO. 81 FINISH—For final application after either one of the above two grades has been used.

NOTE: HANDLES are furnished No Charge. However, it should be noted that due to the texture of No. 81 Resurfacers the Block or Tool Type Handles can not be attached.

HANDLES are mounted parallel to the length of the Resurfacer unless otherwise specified. (See pages 7 and 8 for standard types of handles available.)



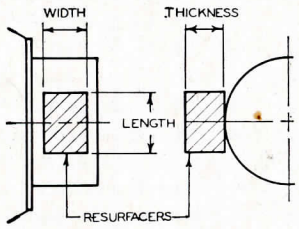
Double Handle Resurfacer being used on large rotary converter.



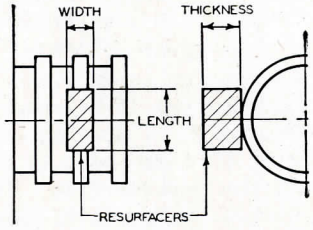
No. 81 "Steel Cutting" Resurfacer being use on slip ring.

HOW TO ORDER

For Commutators



For Slip Rings



The Length, Width and Thickness of a Resurfacer with relation to the commutator or slip ring are as indicated in the above diagrams.

WHEN ORDERING BE SURE AND SPECIFY:

(1) Length X Width X Thickness; (2) Grade; and (3) Type of Handle desired. Also specify if Resurfacer is for commutator or ring work—if for rings, specify the type of rings; i.e. copper, bronze, iron or steel.

Refer to the above sketch for explanation of dimensions. Use standard catalog size whenever possible.

PROPER SIZE AND GRADE:

A Resurfacer with the largest face possible to use on the commutator or ring being ground is recommended for speed, accuracy and economy. Thickness should be from 2″ to 5″ dependent on other dimensions. A thicker Resurfacer has longer life with less waste. The correct grade may be determined from the table listing the various grades available. See pages 7 and 8 for standard catalog sizes.

HAND TYPE FOR COMMUTATORS:

Use a Resurfacer of a length about ¾ the length of the commutator bar and as wide as will conveniently go between the brush rigging. For periodic application, three or four sizes are sufficient in most plants. For major attention, the correct size should be used.

HAND TYPE FOR SLIP RINGS:

When space permits, use a Resurfacer about 1″ wider than the face width of the ring. The length should be at least three times greater than the longest flat spot in order to bridge over and assure a true ring.

Resurfacers are arced at no charge—just give diameter of ring.

NOTE: A Commutator or Slip Ring Resurfacer gives full service when fully arced to the commutator or ring surface. Be sure to consider the depth of arc when specifying thickness.

Experienced Maintenance Engineers At Your Service

If you are unable to determine the proper size and grade Resurfacer to order—give the diameter of commutator or ring, the face width, clearance between sets of brushes, and general condition of commutators or rings. Experienced IDEAL Engineers will be glad to make complete recommendations.

RESURFACERS

Patented—No. 1,660,316

PENCIL TYPE

For Fractional Horse Power Motors

Standard size, 6" x 5/8" x 3/8"

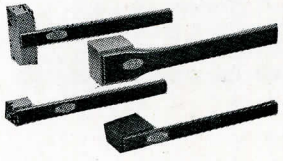
The "Pencil Type" Resurfacer is used for maintaining commutators of starter motors, auto generators, locomotive head light motors, fan or signal motors and other fractional horse power motors. Also cleans contact points, etc. A handy tool for the Tool Kit.

FAN-SMALL MOTOR TYPE

Standard size, 3/4" x 1/2" x 3/8"

This IDEAL Resurfacer is made with one grade of stone on one end and another grade on the other end of the handle —for example, "medium" grade and "finish" grade. A handy utility tool for use on small fractional horse power motors. Length of handle 9 inches.

STRAIGHT HANDLE TYPE



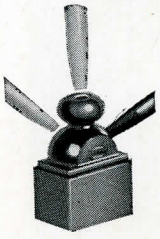
This type is used primarily on inaccessable types of commutators on small or enclosed motors. Length of handle 10 inches. NOW AVAILABLE—Large Straight Handle for Resurfacers as big as 8"x2"x4" and 6"x3"x4".

STOCK SIZES

(Specify Grade Desired)

L.	W.	T.	L.	W.	T.
1 "	x 1 "	x 2"	2"	x 1"	x 2"
1 1/2"	x 1 1/2"	x 2"	3"	x 1"	x 2"

VERTICAL ADJUSTABLE HANDLE



For use on medium size motors and small generators. Includes a small knob permanently fastened to the Resurfacer with an extra rod handle that can be adjusted to any one of three positions as illustrated. Length of handle 10 inches. A universal type to meet practically all conditions.

STOCK SIZES

(Specify Grade Desired)

L.	W.	T.	L.	W.	T.	L.	W.	T.	L.	W.	T.
2"	x 1 1/2"	x 2"	3"	x 1 1/2"	x 2"	3"	x 3 "	x 3"	4"	x 2"	x 3"
2"	x 2 "	x 2"	3"	x 2 "	x 3"	4"	x 1 1/2"	x 2"	4"	x 3"	x 3"

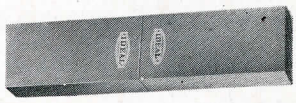
RAILWAY HANDLE

This is a stout handle with a good grip, permanently mounted in a vertical position. Length of handle 7 1/2 inches. Standard size stones same as for Vertical Adjustable Handle.

TRAMWAY HANDLE

Well shaped to assure a good grip. Permanently mounted at 45 deg. angle. Length of handle 10 1/2 inches. Standard sizes same as shown for Vertical Adjustable Handle.

POCKET TYPE

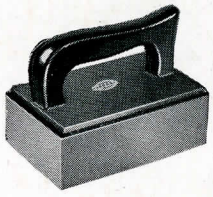


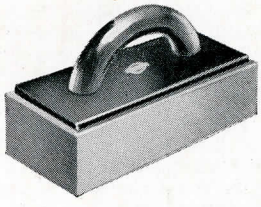
Standard Sizes	Cutting Face
6" long	2" x 1"
8" long	2" x 1"

A handy "two-in-one" utility tool for all around shop practice. Especially designed for use on small motors and generators. Convenient size makes it easy to carry in the pocket or Tool Kit.

Made up in any combination of the five grades, two grades being securely cemented together. When ordering be sure and specify the size and grades wanted.

"SAW" AND "U" HANDLES





For use on large motors, small rotary convertors, motor-generator sets, telephone generators, etc. The "U" handle is preferred when the Resurfacer is to be used with the handle parallel to the brush arm. The "Saw" handle is desirable when the Resurfacer is to be used with the handle at right angles to the brush arm.

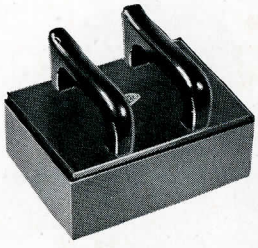
The handle is always mounted parallel to length (first dimension given) unless otherwise requested.

STOCK SIZES

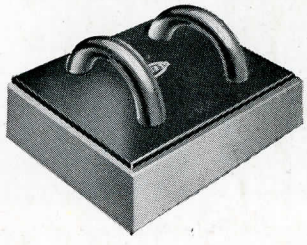
(Specify Grade Desired)

L.	W.	T.	L.	W.	T.	L.	W.	T.
4"	x 4"	x 3"	6"	x 3"	x 3"	7"	x 4"	x 4"
5"	x 2"	x 2"	6"	x 4"	x 3"	8"	x 2"	x 3"
5"	x 3"	x 3"	6"	x 5"	x 4"	8"	x 3"	x 4"
5"	x 4"	x 3"	6"	x 6"	x 4"	8"	x 4"	x 4"
5"	x 5"	x 3"	7"	x 3"	x 3"	9"	x 4"	x 4"
6"	x 2"	x 2"						

DOUBLE "SAW" HANDLE AND DOUBLE "U" HANDLE



Made especially for use on large rotary convertors, large engine driven generators and very large motors such as used in steel mills, etc. All sizes listed below are equipped with two handles which allows for two hand control. Supplied with either the convenient "Saw" or "Flat Iron (U)" type handles as desired. The handles are securely fastened—they will not come loose. The Resurfacer can be used practically up to the last grain.



STOCK SIZES

(Specify Grade Desired)

L.	W.	T.	L.	W.	T.
7"	x 5"	x 4"	12"	x 4"	x 4"
8"	x 5"	x 4"	12"	x 5"	x 4"
8"	x 6"	x 4"	12"	x 6"	x 4"
8"	x 8"	x 4"	12"	x 8"	x 4"
9"	x 5"	x 4"	14"	x 4"	x 4"
9"	x 6"	x 4"	14"	x 6"	x 4"
10"	x 4"	x 4"	14"	x 8"	x 4"
10"	x 5"	x 4"	16"	x 6"	x 4"
10"	x 6"	x 4"	16"	x 8"	x 4"
10"	x 8"	x 4"	16"	x 10"	x 4"

IDEAL Resurfacers weigh approximately 1 pound for every 10 cubic inches.

See Hints and Tables, Pages 71 to 88

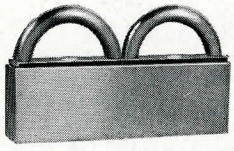
RESURFACERS

Patented—No. 1,660,316

SLIP RING TYPE

Made to meet conditions of all rings. The standard Resurfacer is recommended for brass or bronze rings and No. 81 Resurfacer for iron or steel rings. See page 6 for instructions when ordering.

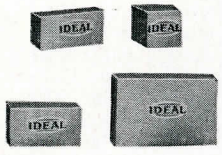
Sizes listed can be supplied with either "Saw" or "U" Type Handles. If diameter of ring is given, the Resurfacer will be concaved accordingly at no charge.



STOCK SIZES
(Specify Grade Desired)

L.	W.	T.	L.	W.	T.	L.	W.	T.
4"	x 1 "	x 3"	6"	x 2"	x 3"	10"	x 2"	x 4"
4"	x 1½"	x 3"	6"	x 3"	x 3"	10"	x 3"	x 4"
4"	x 2 "	x 3"	7"	x 2"	x 4"	12"	x 2"	x 4"
5"	x 1½"	x 3"	7"	x 3"	x 4"	12"	x 3"	x 4"
5"	x 2 "	x 3"	8"	x 2"	x 4"	14"	x 2"	x 4"
5"	x 3 "	x 3"	8"	x 3"	x 4"	14"	x 3"	x 4"
6"	x 1½"	x 3"						

SPECIAL TYPES

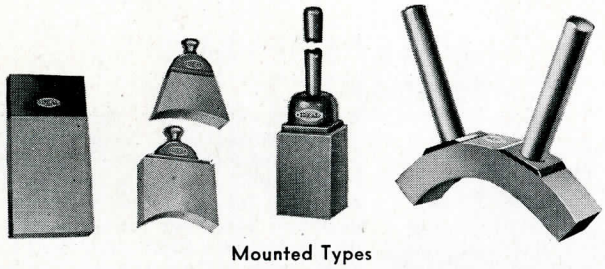


Unmounted Types

In addition to the standard sizes and type Resurfacers illustrated, other sizes and shapes are available — made to meet particular applications or conditions.

All IDEAL Resurfacers are made to the same exacting specifications and uniformity that assures *fast cutting action—always*! The handles are permanently fastened so that they cannot come loose. There is no waste with IDEAL Resurfacers for they can be used right down to the handle.

When ordering special size Resurfacers, it is advisable to give complete information regarding use and application. IDEAL Engineers are at your service so feel free to ask their help with individual problems.



Mounted Types

BLOCK HANDLE OR TOOL TYPE

For Use With IDEAL Precision Grinders

This type is for use in IDEAL Commutator and Slip Ring Portable Precision Grinders or any type of lathe truing device.

"Tool Type" Resurfacers are equipped with wood block handles for clamping rigidly in the Grinder—allowing the entire stone to be used.

For the "Midget" Grinder the standard cutting face is 1"x1½"x5" long, plus a 1½" block handle.

The standard size for the "Ideal" and "Perfect" Model Grinders is 2"x2"x5" long, plus a 3" block handle.

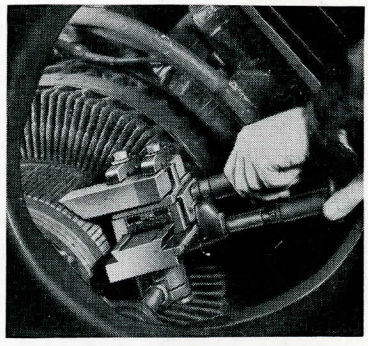
To remove a large amount of copper, "Coarse" or "Extra Coarse" Resurfacers should be first used, followed by the "Medium" or "Finish" grade, and then "Polish" grade to give the commutator a highly burnished finish. Best results are obtained after Resurfacers have shaped themselves to the surface.

NOTE: The No. 81 "Tool Type" Resurfacers for iron or steel rings cannot be furnished with a wooden handle. Thus, if an 8" long Resurfacer overall is desired, it must consist entirely of Resurfacer material without a handle.

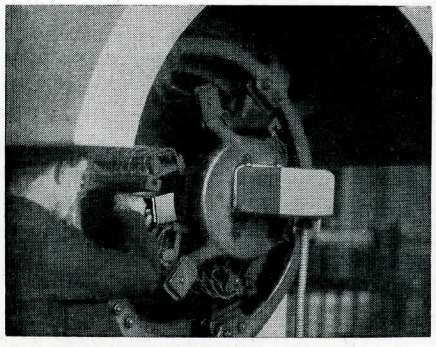
SIZES
(Specify Grade Desired)

Cutting Face	Length	Cutting Face	Length
1 " x 1 "	5" or 8"	2½" x 1½"	5" or 8"
1 " x 1½"	5" or 8"	2 " x 2 "	5" or 8"
1½" x 1½"	5" or 8"	3 " x 2 "	5" or 8"
2 " x 1 "	5" or 8"	3 " x 3 "	5" or 8"

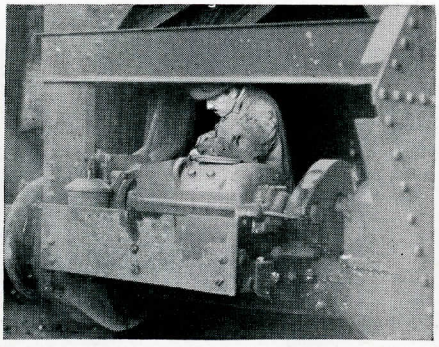
IDEAL Tool Type Resurfacers are recommended for all Grinding jobs because of their unparalled efficiency, showing 85% copper removed to 15% of Resurfacer used. They never drag copper from bar to bar, never clog with copper. The fastest cutting Resurfacer on the market.



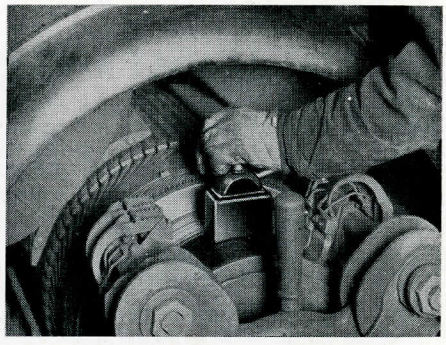
NOTE: Ideal Resurfacers weigh approximately 1 lb. for every 10 cubic inches.



Showing convenience of grinding a generator-exciter commutator without removing protective hood.



Resurfacing commutator of 10 H.P. Peal Drive Motor (open hearth charger) with Peal operating idle.



High ridges being ground down quickly with coarse grade Resurfacer — no dismantling.

COMMUTATOR CLEANING STONE

Quickly Removes Excessive Film!

- *Will not cut commutator*
- *Easy to use — merely hold against commutator*
- *Does not clog*
- *Helps to seat brushes as it cleans*

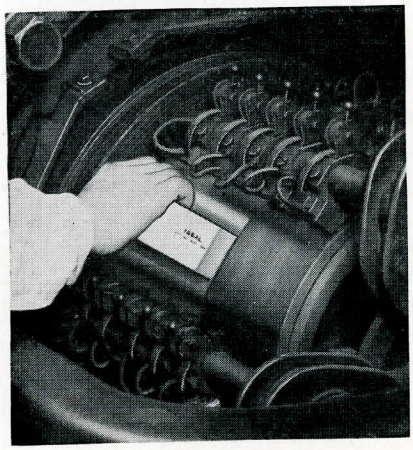
Dirt, smudge, excessive film and brush material are all quickly removed with this new Commutator Cleaner. Made of a grain and bond to produce a scouring effect, it wears away sufficiently for self cleaning, but does not remove or scratch the copper. Does not even touch the natural oxide film or glaze—leaves commutator or ring clean and perfectly conditioned.

Used by simply holding against the commutator as it turns and slowly moving from side to side. Especially suitable for removing excess "color," "skin" or "film," resulting from oxidation around paper mills, chemical plants, plating departments, diesel locomotive generators, etc.

Increases Brush Performance

Dry—completely di-electric—safe. Produces an effect of slightly reseating brushes to the natural commutator or ring face. Removes any dirt, ash accumulation or copper flaking from the brush face, preventing distinctive selective action.

Clean commutators assure better all-around brush performance with less noise, even distribution of brush contact drop, even brush wear, no chattering, and minimum sparking. The best and least expensive way to step up motor and generator efficiency. 10 cu. in. weighs approximately ½ lb.

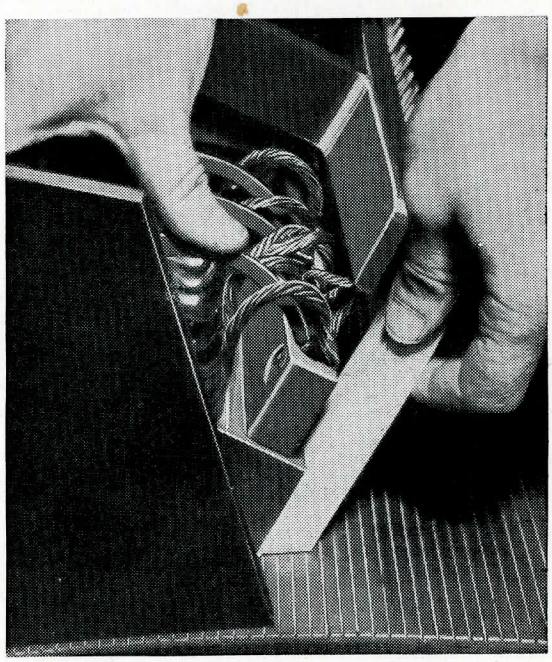


9 Sizes

4¾"	x ½"	x ⅜"
4¾"	x 1 "	x 1 "
4¾"	x 2 "	x 1 "
2 "	x 2 "	x 2 "
3 "	x 2 "	x 2 "
4 "	x 3 "	x 2 "
5 "	x 2 "	x 2 "
6 "	x 3 "	x 2 "
8 "	x 3 "	x 2 "

CARBON BRUSH SEATER

Seats Under Actual Operating Conditions!



Seats carbon brushes rapidly, easily and perfectly. Each brush is seated under actual operation conditions, without shutting down the machine, consequently a perfect and accurate seat is given—increasing commutator efficiency. Sparking and chattering due to poor brush contact is instantly stopped through a few moments application.

Aids Commutation

The IDEAL Brush Seater is made of soft loosely bound grain, completely di-electric. *It does not scratch or cut the commutator.* The combination of the material removed from the brush and the Brush Seater gives the commutator or ring a high polish which aids commutation.

Simple to use—just hold the Brush Seater at the heel of the brush and press down on the brush to increase the pressure. The friction of the revolving commutator or ring releases the brush seater material, which is carried under the brush.

With the IDEAL Brush Seater, there is no added thickness of abrasive paper or cloth to produce errors, causing the brush to ride heel or toe—no wobbling in the brush holder to produce uneven seating.

Especially valuable in seating large metal composition brushes as used on rotary converter rings and low voltage plating generators. 10 cu. in weighs approximately ½ lb.

Many Sizes

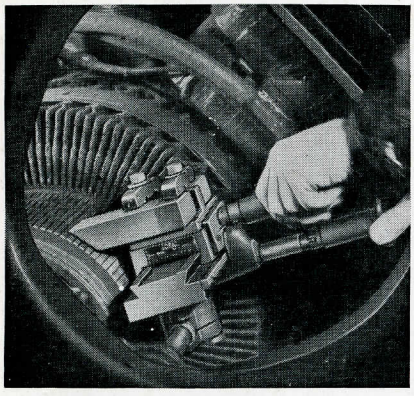
STANDARD SIZE—4¾" long x 1⅛" x ⅝" face.

OTHER SIZES—

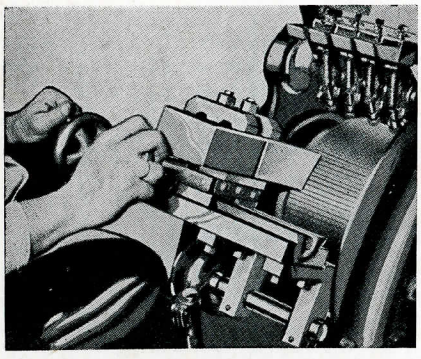
4¾" x ¼" x ¼"	4¾" x ⅜" x ⅜"	4¾" x ½" x ½"
4¾" x ½" x ¼"	4¾" x ½" x ⅜"	4¾" x ⅝" x ½"
		4¾" x ¾" x ½"

PRECISION GRINDERS

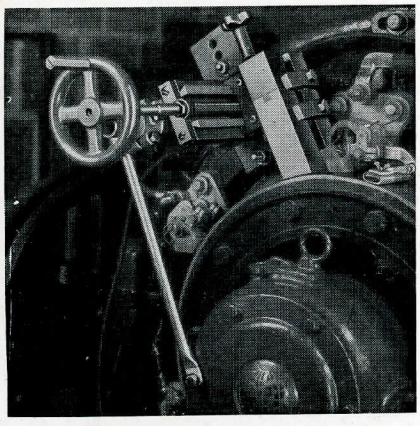
True Commutators And Slip Rings In Their Own Bearings At Normal Operating Speed. No Dismantling Necessary!



IDEAL "Midget" Grinder permits accurate adjustment. Grinder mounted on brush rigging.



Precision Grinder being used while motor is in operation.



IDEAL "Perfect" Model Grinder mounted on slow speed elevator motor.

If through mishap, neglect or failure to apply preventative methods, a commutator or slip ring becomes exceedingly rough, deeply grooved or eccentric, the hand application of Resurfacers is not as satisfactory as using an IDEAL Precision Grinder for precision truing and complete commutator or ring reconditioning.

Over the years, various methods of commutator and slip ring reconditioning have been introduced; i.e. removing the armature or rotor for turning in a lathe, cutting down the commutator with a steel tool while armature or rotor is slowly turned by separate belted motor, grinding with a rotary abrasive wheel, etc. However, the best method—the one that has stood the test of time and economy is the IDEAL Precision Grinder. *Thousands of plants have standardized on IDEAL Grinders* for both large and medium size equipment.

Grind To Accuracy Of 1/1000 inch

Concentricity to 1/1000" at normal speed is easy with the IDEAL Precision Grinder, for it mounts directly onto the brush arm or improvised support and grinds with the armature or rotor turning at its normal operating speed. Thus the commutator or ring is under normal centrifugal stress. This accuracy is not possible to produce with other methods, such as turning in centers or in bearings with running tolerances and oil film other than its own. Steel tools for turning in place will not stand the stress of speed sufficiently to produce normal conditions. And, rotating abrasive wheels require very massive unportable mountings, or chatter is inevitable.

Compact—Portable

Grinding the IDEAL way is often called "honing." This produces a minimum of drag or load, with no chatter. Though comparatively massive and strong for the purpose, IDEAL Portable Precision Grinders are relatively small and weigh under 50 lbs., even in the longer lengths, thus carrying the Grinder to the job and mounting it is easy. Compare this to the crane—mountings for other "in place" means or dismantling of the machine, transporting the armature or rotor to a proper lathe, returning and reassembly.

Economical

With an IDEAL Grinder, a commutator or slip ring reconditioning job can ordinarily be completed in the time necessary for just the disassembly where the rotor or armature is carried to a lathe. One man (or two for safety) can do the job—no gang, no crane nor truck is needed. There is no danger of damage to windings through bumping, nor of springing or damaging of shafts.

Only enough copper or brass is removed to produce complete concentricity. A full "cut" need not be taken. And, most important, *the equipment which the motor or generator services, is out of productive service a minimum of time.*

Assures Perfect Commutation

With an IDEAL Precision Grinder, high portions of eccentricities and flats are ground off until perfect concentricity is produced. The cross-feed action grinds off the high portions of grooves and ridges until a perfectly straight face is produced.

Grinding drag or load is distributed over the large Resurfacer face area, therefore, the distorting of bars, pressing down or raising to shift again in service, or gouging as with a steel tool, is impossible. IDEAL Tool Type Resurfacers of the "Extra Coarse" and "Coarse" Grades remove copper and brass exceedingly fast. The finer grades bring up the surface ready for perfect brush contact. There is no scoring nor tool marks. The "Polish" Grade gives up an actual mirror finish.

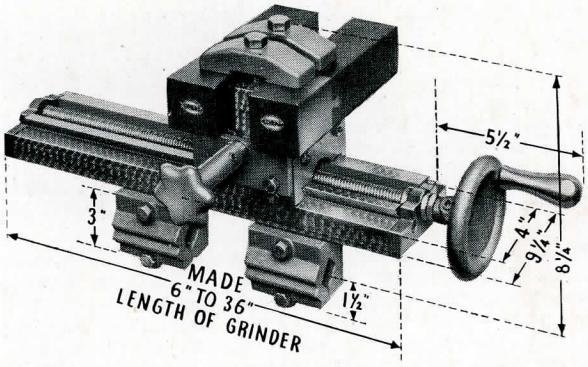
IDEAL Commutator Resurfacers are completely di-electric, so may be safely used in IDEAL Grinders mounted on moderate voltage equipment turning under its own power, if necessary, under some load.

See Hints and Tables, Pages 71 to 88

PRECISION GRINDERS

(Supplied With Carrying Case—No Charge)

"PERFECT" MODEL



For Open Type Commutators And Rings

The IDEAL "Perfect" Model Grinder is a high grade Precision Tool for use with IDEAL Tool Type Resurfacers. All parts are machined to close tolerances to assure close fitting, free moving, rigid support for the Resurfacers. The bed-plate is of one piece, cast iron construction with wide, machined-and-ground bearing surfaces. "V" ways are provided to carry the movable head. Slots in the base permit grindings to fall through freely.

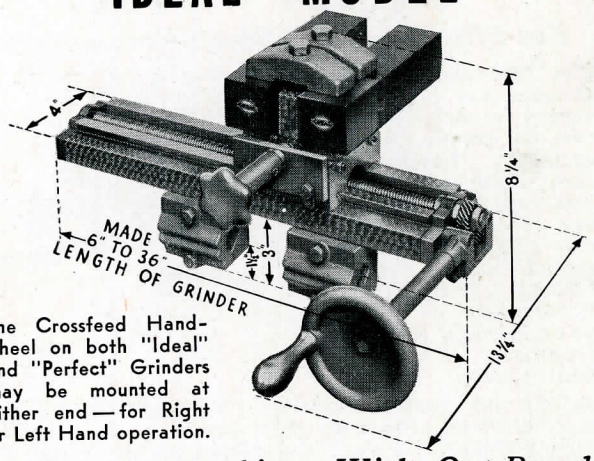
The carriage for supporting the Tool Type Resurfacers is machined to a close fit on the base ways and has a heavy bronze nut engaging with the lead screw of the base. This bronze nut minimizes wear on the screw and can be easily replaced to take care of wear which might develop during the life of the tool. Adjustable lock nuts are also provided on the end of the lead screw to take up for possible wear. The infeed adjustment of the Resurfacer has a center type feed screw engaging the solid cast iron top-plate which has machined "V" ways accurately cut at right angles to the crossfeed ways.

The crossfeed screw-plate is removable for mounting on either side of the base so that the Grinder *can be made either right or left hand.* Gibs are provided on the "V" ways for accurate adjustment and to allow take-up for normal wear.

The "Perfect" Model Precision Grinder is furnished in any one of 16 different lengths ranging from 6" to 36" inclusive by 2" variations. Bases up to 14" long have 2 brush arm supports only, while bases 16" long and over are furnished with three supports.

CATALOG NO. 24-004 (formerly No. 6) Standard Grinder with 12" base. Supplied unless otherwise specified. Weight, 35 lbs.

"IDEAL" MODEL



The Crossfeed Handwheel on both "Ideal" and "Perfect" Grinders may be mounted at either end — for Right or Left Hand operation.

For Use On Machines With Out-Board Fans, Large Bearing Pedestals, Or Close End Frames.

Except for the right angle drive crossfeed, the construction of the "Perfect" and "Ideal" Model Grinders is the same.

The crossfeed lead screw is driven through a pair of spiral gears and a revolving handwheel which extends at right angles to the crossfeed screw. The drive bracket is mounted at one end of the Grinder base and is arranged so that it can be fitted to either side of the base, for either right or left hand mounting.

The two heavy Resurfacer clamps at the top of the head are bolted to the center lug between the Resurfacers. The center lug is bevelled on each end to allow swiveling of the Resurfacers for working into close corners and against the risers on commutators.

The "Ideal" Precision Grinder is furnished in any one of 15 different lengths ranging from 8" to 36" inclusive, by 2" variations. Bases up to 14" long are furnished with 2 brush arm supports, while bases 16" long and over have 3 supports.

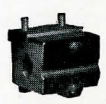
The larger size Grinders can be used for small commutators or slip ring jobs by simply allowing the excess length of the Grinder to extend out beyond the face of the commutator or ring. 12 inch base standard.

NOTE WHEN ORDERING — the end plate and handwheel assembly, add approximately 2" to the Grinder base length, thus a standard 12" Grinder really has only a 10" base plate—this plus the 2" make a 12" overall length.

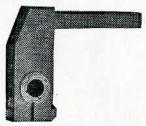
CATALOG NO. 24-020 (formerly No. 8) Standard 12 inch Grinder. Supplied unless otherwise specified. Weight 35 lbs.

Tool Type Resurfacers are not supplied as part of the Grinder. See page 8 for specifications of Tool Type Resurfacers.

Supports For "Perfect" and "Ideal" Model Precision Grinders



24-043



24-035

24-042

SPECIAL BRACKET SUPPORTS—When brush arms are not strong enough to hold the Grinder, or if they are oddly formed, improvised mountings for anchoring on the frame or pedestal bolts can readily be made with bent angle iron or rod.

Small "U" Supports supplied unless otherwise specified.

CATALOG NO. 24-043 Small "U" Support for round brush arms 7/16" to 1½" diam. Two halves are separable (supplied as standard.)

CATALOG NO. 24-035 Large "L" Support for round brush arms, 1¼" diam. or less. Slips over end of arm.

CATALOG NO. 24-042 Wedge Support for flat brush arms.

See Hints and Tables, Pages 71 to 88

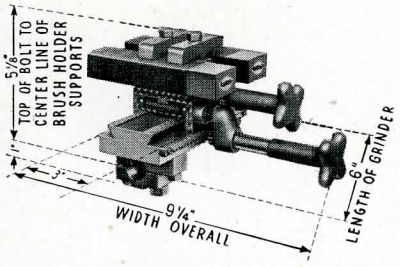
PRECISION GRINDERS

(Supplied With Carrying Case—No Charge)

"MIDGET" MODEL

For Slip Rings and Small Commutators

The "Midget" Model Grinder has been designed especially for use on smaller commutators, having a face width of 8" or less, as well as for use on medium-size slip rings. It is designed for use with IDEAL Tool Type Resurfacers — compact design allows working into very small spaces.



Infeed and crossfeed carriage "V" ways are accurately machined and ground to close fitting tolerances. Crossfeed is through a rack and pinion which is free from clogging and permits bringing the crossfeed hand wheel out radial to the shaft of the machine. This permits working down into narrow spaces where motor end bells or brush yokes prevent the use of a cross-feed screw parallel to the axis of the machine.

Two clamps are provided for holding the Resurfacer Tools to the carriage, and the divider between the Resurfacers is bevelled at each end to permit skewing of the stones for working into close corners and against the risers of the commutator. Length of base 6 in. only.

CATALOG NO. 24-033 (Formerly No. 4). Includes Short "L" Supports or any other type as selected. Does not include Tool Type Resurfacers. Weight, 18 lbs.

Brush Arm Supports

No. 24-038 No. 24-037 No. 24-039 No. 24-043 No. 24-042

NO. 24-038 —Short "L" for round brush arms 1 in. diam. or less (supplied as standard). Two required.

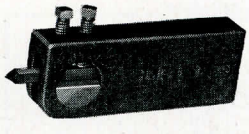
NO. 24-037 —Long "L" for round brush arms, 1 in. diam. or less. Two required.

NO. 24-039 —Center Support for round brush arms 1 in. diam. or less. One required.

NO. 24-043 —Small "U" for round brush arms 7/16" to 1½" in diam. Two halves are separable. One required.

NO. 24-042 —Wedge Support for flat brush arms. One required.

LIGHT DUTY TURNING TOOL



A handy economy model turning tool for removing the ridges or bead of copper left at inner edge of commutator next to the riser. Can be used to remove excessive amounts of copper also, but does not have the greater rigidity present in the Lathe Type Turning Tool Head. Has same shape as Resurfacer, and clamps right into Grinder in place of Tool Type Resurfacer. Weight 1 lb.

NO. 24-040 —For "Perfect" and "Ideal" Model Grinders.

NO. 24-041 —For "Midget" Model Grinders.

TOOL TYPE RESURFACER

IDEAL Tool Type Resurfacers for use in "Ideal" and "Perfect" Model Grinders are made with cutting faces up to 2½"x2½"x5" or 8" long (plus block handle). The standard cutting face is 2"x2"x5" long (8" overall with block handle).

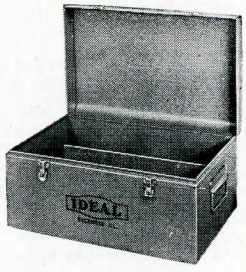
For the "Midget" Model Grinder, the standard cutting face is 1"x1½"x5" long (6½" overall with block handle.)

IDEAL Resurfacers are recommended for all grinding jobs because of their unparalleled efficiency, showing 85% copper removed to 15% of Resurfacer used. They never drag copper from bar to bar, never clog with copper. The fastest cutting Resurfacer on the market.

SEE PAGE 8 FOR ADDITIONAL SPECIFICATIONS

CARRYING CASE

Supplied with all IDEAL Grinders at no charge. A light weight all metal case, handy for carrying Grinders between jobs and for storing when not in use. Different size cases furnished depending upon length of Grinder base.

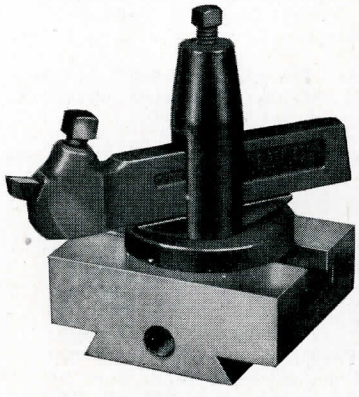


LATHE TYPE TURNING TOOL HEAD

For Use With IDEAL Grinders

Although the use of IDEAL Resurfacers is much to be preferred in reconditioning commutators, it is sometimes desirable to cut away a large amount of copper. The IDEAL Lathe Type Turning Tool Head is excellent for this work. The Lathe Type Turning Tool Head when placed on the Grinder (in place of regular Grinder head) duplicates the carriage and cross-slide of a lathe and will perform a job similar to that obtained by removing the armature and turning down the commutator in a lathe.

After turning down the commutator or rings, IDEAL Tool Type Resurfacers should always be used to give a smooth finish.



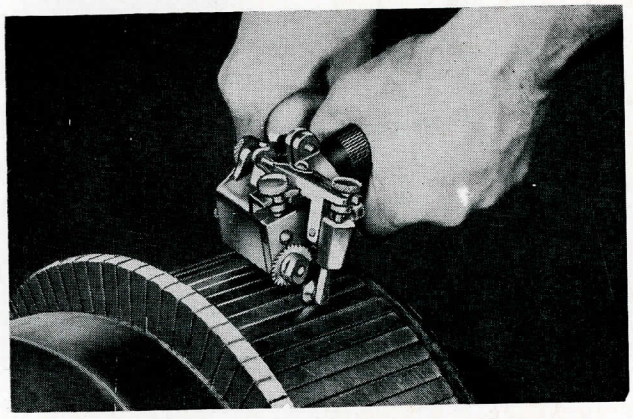
When using the tool the commutator must be turned over slowly, either by use of an auxiliary motor, or gear and belt reduction. On large machines, the armature may be allowed to "coast" until a safe cutting speed is reached and then the cutting operation begun. Includes a high speed steel tool bit, tool holder, tool post fittings, spot finished cast iron base and tool post wrench. Weight 7 lbs.

NO. 24-045 —For "Perfect" and "Ideal" Model Grinders.

NO. 24-046 —For "Midget" Model Grinder.

MICA UNDERCUTTERS

Undercutting Permits Use Of Modern, Efficient Brushes—Assures Good Commutation—Prevents Sparking And Spitting Caused By High Mica.



"UNIVERSAL" MODEL

There has been some question in past years regarding the advisability of undercutting commutators—however, *modern practice dictates undercutting universally,* except in remote, special service cases. This is true with the smallest flea power motors as well as the largest generators and rotary converters. Some manufacturers are now even undercutting radial commutators which are contacted only while starting.

The form of slot may vary according to the location of the equipment, the service it renders and the choice of the user. But the purpose universally is to remove all of the mica between the segments to a depth—a good rule is—"As deep as it is wide."

The removal of all of the mica between the segments is imperative. Mica is built up of flakes or thin layers, and if the thinnest fin or section (often invisible to the naked eye) is left along the side of the slot, the brushes will be raised off the commutator, causing poor commutation—spitting and burning, exactly as though there were no undercutting at all. Thus, most common practice is to remove a slight amount of copper along both sides of the slots.

Four Sizes of IDEAL Undercutters

IDEAL Commutator Mica Undercutters simplify and speed up the undercutting operation. Four sizes are available for small, medium size and large commutators —for undercutting without dismantling, by removing the brush rigging only; or for undercutting with the armature removed from the machine and held in a stand.

IDEAL Undercutters cut smoothly and evenly without vibration—right up close to the riser. Balanced design permits their use for a long period of time without tiring the operator. Proper cutting speed assures long saw life.

Do Undercutting In Spare Time

Frequently it is very difficult to spare machines for the time required to undercut the entire commutator. As the IDEAL "Universal" and "Direct Drive" Models eliminate dismantling, the undercutting can be done a little at a time, while the machine is not in service, and when needed, it can be thrown back on the line at any time.

After undercutting, the IDEAL Hand Slot Scraper offers the most convenient means for bevelling or smoothing the sharp edges left at the sides of the slots.

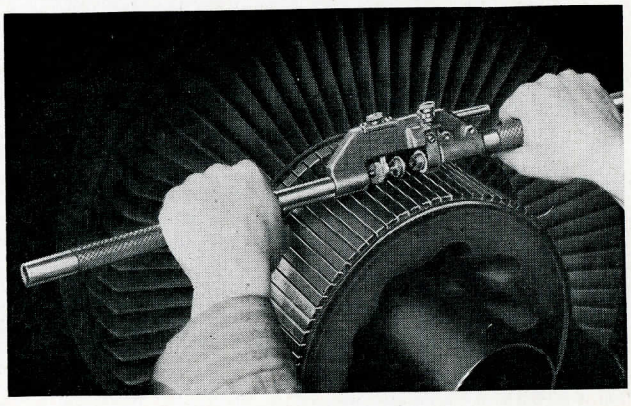
"U" Slot OR "V" Slot?

Whether to undercut the mica with a Saw to produce a "U" Slot, or with a Milling Cutter to produce a "V" Slot must be determined by the user. This depends upon the service required and the conditions under which the equipment must operate—each type of slot has its advantages and disadvantages.

"U" SLOT SAWS are available in various thicknesses (see page 17). The correct thickness is from 1 to 3 mills wider than the mica which means that a slight amount of copper will be removed from both sides of the slot. Every effort should be made to leave not even the slightest fin of mica along the slot wall, otherwise the purpose of undercutting is defeated. Various thicknesses of saws should be carried in stock. "U" Slot Saws cut to a full depth, thus requiring less frequent undercutting. However, as the commutator rotates, eddy currents of air are set up in the "U" Slots causing carbon dust and foreign matter to gather which makes possible shorts and leakage between bars, especially in industries and locations where dust and dirt are inevitable.

"V" SLOT MILLING CUTTERS are available in one thickness only—.045" and bevelled to undercut all mica from .015" to .045" thick—(see page 17). The "V" Slot with a copper bevel at the top eliminates the possibility of invisible mica flakes along the slot side. *Effective undercutting is only the depth of the copper bevel.* A Miller because of its larger cutting face will outlast four to six Saws. Since the "V" formation leaves no angle in which dirt may lodge and is also self-ventilating, a "V" undercut commutator may have surface reduction by bevelling as much as 10% without a single degree of temperature rise. The obtuse angles at the bar edges reduce noise and increase distance between arcing points.

Generally speaking, the "U" Saws are recommended where deep effective undercutting is desired and the equipment will be kept relatively clean. The "V" Slot Milling Cutters are recommended in industry where maintenance facilities are readily available.



"SHOP" MODEL

See Hints and Tables, Pages 71 to 88

MICA UNDERCUTTERS

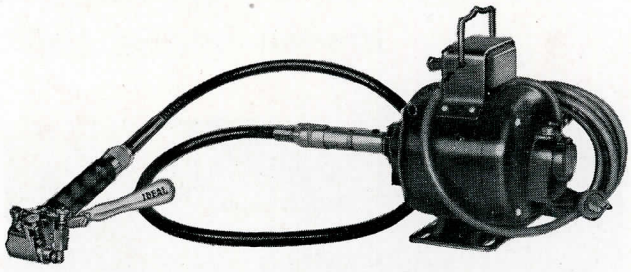
"UNIVERSAL" MODEL

For Large And Small Commutators

The smallest—most powerful undercutter on the market! Of rugged design, for continuous heavy duty service. Cuts evenly and smoothly without vibration, assuring uniform slot depth.

The cutting head is only 2¾" wide, making it especially well adapted *for field service* with brush rigging in place. Flexible, rugged and free from chatter. Easily works in close quarters within frames, around busses, shrink rings and yokes. Accurate adjustments permit tilting to most any practical angle. Also ideal for *shop service* with armature on stands or in a lathe.

Easy to handle because the driving motor is back out of the operator's way. There is no weight except that of the compact head to support. Motor, shaft and head swing in line with the slot. There is no side pull, thus making it easy to guide the cutter and prevent twisting of the cutter blade in the slot.

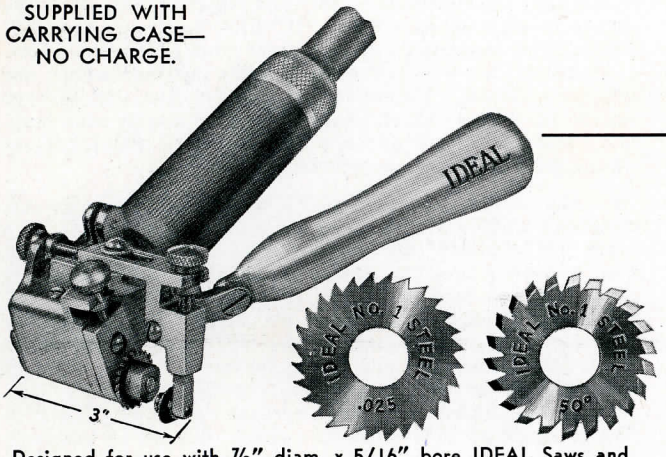


Motor is ¼ HP, 1750 RPM (½" shaft) equipped with hanger, overload circuit breaker, 10 ft. cord and plug. Has swivel motor connection and 4 ft. flexible shaft. Cutting head is of ball bearing construction with spiral gear drive to cutting spindle. Spindle speed 1750 RPM. Includes either 4 Milling Cutters or 8 Saws, as specified. (Auxiliary Handle not included). Weight, head only 4½ lbs. Weight complete with motor, 50 lbs. (Formerly Catalog No. 7).

NO. 25-029.....115 v, 60 cy.	NO. 25-031.....115 v, 25 cy.
NO. 25-032.....230 v, 60 cy.	NO. 25-034.....230 v, 25 cy.
NO. 25-035.....115 v, D.C.	NO. 25-036.....230 v, D.C.

NO. L-1155A.....Auxiliary Handle

SUPPLIED WITH CARRYING CASE— NO CHARGE.



Designed for use with ⅞" diam. x 5/16" bore IDEAL Saws and Milling Cutters.

FEATURES

1. Overall width with guide only 3"
2. Ball bearing construction
3. Spindle driven by spiral gear
4. Depth gauge with adjustment and positive lock
5. Pitch gauge with adjustment and positive lock
6. Roller guide—rides in adjacent slot assuring accuracy
7. Large guide handle for a good grip. Auxiliary handle (illustrated) available.
8. Cuts to within ¼ in. of riser
9. Works in a space only 2¾" wide
10. Balanced design — does not fatigue operator

"SHOP" MODEL

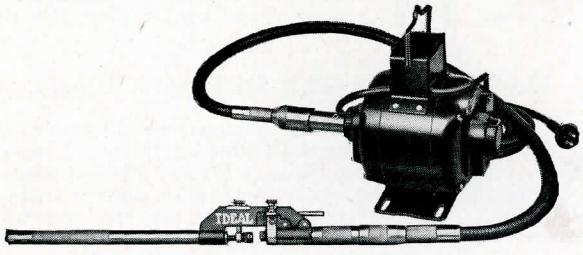
For Large Commutators

Designed particularly for shop service with the armature on stands, or for field service when the brush rigging and other obstructions have been stripped.

The cutting spindle is driven by separate motor through flexible shaft (same as IDEAL "Universal" Model). Adjustment guide, depth gauge and radial adjustment permit accurate cutting—to within ¼ in. of commutator riser. Knurled handles in handle bar manner afford easy full view control.

Motor is ¼ H.P. 1750 RPM (½" shaft) equipped with hanger and circuit breaker, 10 ft. cord and plug. Has swivel motor connection and 4 ft. flexible shaft. Undercutter Head has anti-friction bearings. Designed for use with ⅞ in. diam. x 5/16 in. bore IDEAL Saws and Milling Cutters. Includes either 4 Millings Cutters or 8 Saws, as specified. Weight of head only, 4 lbs. Length 21". Weight complete with motor and carrying case, 50 lbs. (Formerly catalog No. 11).

NO. 25-038.....115 v, 60 cy.	NO. 25-040.....115 v, 25 cy.
NO. 25-041.....230 v, 60 cy.	NO. 25-043.....230 v, 25 cy.
NO. 25-044.....115 v, D.C.	NO. 25-045.....230 v, D.C.



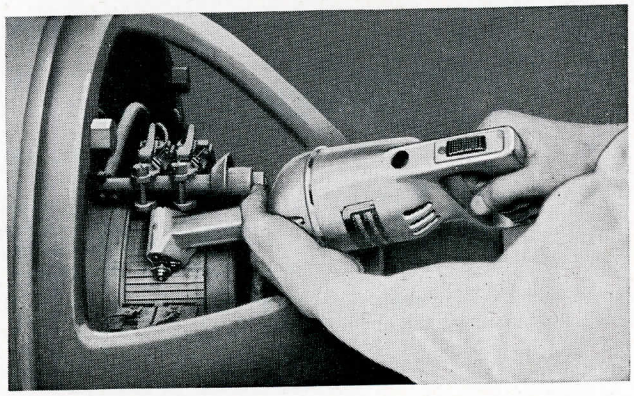
MICA UNDERCUTTERS

"DIRECT DRIVE" MODEL

For Small and Medium Commutators

No other undercutter in its price range approaches the fast, accurate performance of this powerful little unit. No dismantling of brushes or motor is necessary! Especially designed for medium service in the field. The head is of the leading cutter type—only 2½" wide for use between close brush rigging—cuts full slots to within 3/16" of the riser.

Also makes an excellent shop type undercutter for medium service when a universal service undercutter is desired. Direct shaft, high speed drive; the motor and head are completely enclosed within a single sturdy, lightweight housing.

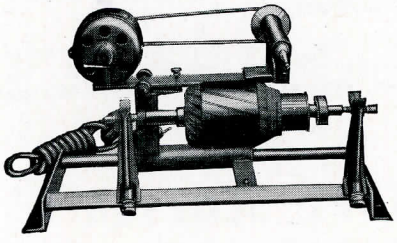


Has sturdy, ample powered, well ventilated universal motor—overpowered for the service for which it is designed. *Will not stall* or slow unduly in any medium service. Equipped throughout with anti-friction bearings. Depth gauge is an eccentric collar, set for proper depth of cut by screw driver adjustment. Roller guide (optional) is adjustable to curvature of armature and width of commutator bar—assures perfect slots.

Has "Universal" type motor. Overall length, 14¼"—width of head, 2½"—cutter spindle speed approximately 3,000 RPM. Designed for use with 23/32" diam. x 5/16" bore IDEAL Saws and Milling Cutters. Standard unit includes either 2 Milling Cutters or 3 Saws, as specified. Weight 5¾ lbs. (Formerly Catalog No. 9).

NO. 25-001.....115 v, AC-DC **NO.** 25-002.....230 v, AC-DC
NO. 25-050.....Roller Guide

"CENTERLESS" MODEL



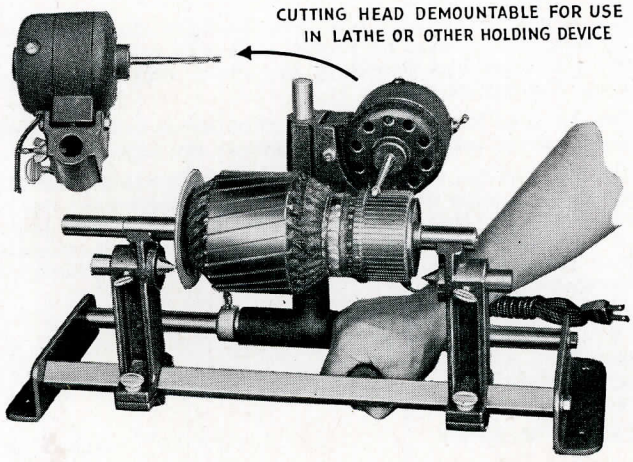
A Light Duty Model—For Small Armatures Up to 7" Diameter. Particularly recommended for the average repair shop or industrial plant. Easy to operate, cuts to uniform depth. Sliding arm is balanced for smooth cutting. Suitable for either centered or uncentered shafts. Designed for ¼", 9/32" or 5/16" diameter saws (⅛" bore).

Includes 115 volt Universal Motor (DC or AC, 25 to 70 cycle) 6' cord with plug and nine assorted ¼" saws. Weight 15 lbs. (Formerly Catalog No. 5).

CATALOG NO. 25-020.....115 v, AC-DC **CATALOG NO.** 25-021.....230 v, AC-DC

"SMALL MOTOR" MODEL

For Fractional Horsepower Motors



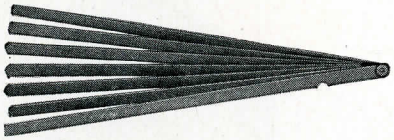
Intended for small armatures from 1" up to 7" diameter—with centered, centerless or hollow shafts. Cuts to a uniform depth, regardless of the level of the armature. Depth of cut is governed by the size of the cutter and by depth adjustment. Designed for use with 1/4", 9/32" or 5/16" diameter saws (1/8" bore). The 1/4" saw cuts 1/32" deep; the 9/32" saw cuts 3/64" deep and the 5/16" saw, 1/16" deep.

V-blocks or centers are used to permit quick adjustment of the armature to its position. And, the Cutting Head can be readily moved up out of way so that bearings, gears or flanges do not have to be removed. Travel of the cutter is controlled in both directions by adjustable stops. Has "universal" type motor (25-70 cycle, AC-DC) with 5' cord. Cutting speed 5000 R.P.M. under load. Includes nine assorted ¼" saws. Size: 21"x8⅜"x10¾". Weight, 16 lbs.

CATALOG NO. 25-048.....115 v, AC-DC
CATALOG NO. 25-049.....230 v, AC-DC

See Hints and Tables, Pages 71 to 88

ARMATURE AIR GAP GAUGES

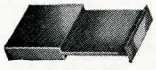


Very useful for plant maintenance work in checking the correct air gap between stator and rotor. By periodically checking these air gaps, worn bearings which allow the rotor to drop in the frame, are detected before the wear becomes excessive. Steps can then be immediately taken to overcome the trouble and the striking of the rotor against the stator or pole pieces can be avoided. Maintenance of uniform air gaps also avoids electrical disturbances in the machine which result in heating, excessive bearing pressure and lowered efficiency.

Gauges are made of thin leaves of specially tempered steel. Each leaf is plainly marked for thickness. Each set has a substantial steel case into which the gauges may be folded when not in use. Blades are ½" wide. Weight 8" size, 4 oz.; 16" size, 8 oz.

Catalog No.	Previous No.	Lgth.	Number of Leaves and Thickness (Inches)							
44-001	No. 81	8'	.002	.003	.004	.005	.006	.008	.010	.015
44-002	82	8'	.002	.003	.004	.008	.016	.024	.032	.048
44-003	83	8	.002	.003	.005	.010	.015	.025	.040	.060
44-004	164	16'	.006	.008	.010	.012	.015	.025	....	....
44-005	165	16'	.005	.008	.010	.015	.025	.040	....	....
44-006	166	16'	.005	.010	.015	.025	.040	.060	....	....

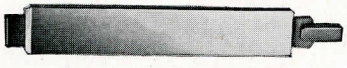
COIL TAMPING TOOLS



IDEAL Coil Tamping Tools are used for tamping wires in slots. Made of heat treated steel—1/16" thick shank permits easy use in the narrowest slot. Overall length 3". Weight, approx. 4 oz.

NO. 43-001.....3/16" x 7/8" **NO. 43-002**.....5/16" x 1¼"
NO. 43-012.....3/8" x 2"

WEDGE DRIVERS



Prevents wedges from breaking or bulging while being driven into place. Made of steel shell and steel driver. When ordering, state width and thickness of wedges or specify size as listed below.

NO. 43-004....1/32" x 3/8" **NO. 43-009**....3/32" x 5/8"
NO. 43-005....1/32" x 5/8" **NO. 43-013**.....1/8" x 3/8"
NO. 43-006....1/16" x 3/8" **NO. 43-010**.....1/8" x 5/8"
NO. 43-007....1/16" x 5/8" **NO. 43-011**..... 1/8" x 7/8"
NO. 43-008....3/32" x 3/8" **NO. 43-014**....3/16" x 3/8"
NO. 43-015....3/16" x 5/8"

COMMUTATOR CEMENT

For filling holes in Commutator Bars; for replacing pitted, charred and burned mica. IDEAL Commutator Cement is a non-conductor, regardless of age and is highly adhesive. When once dry, it stays in place and will not shrink. Can be heated where necessary to dry more rapidly. Packed in jars.

NO. 54-007...½ lb. **NO. 54-008**...1 lb. **NO. 54-009**...2 lbs.

SLOTTING FILES

CATALOG NO. 20-012.....7¼" Straight 3-Edge Cutting Type

CATALOG NO. 20-013.....7" Knife Edge Type

CATALOG NO. 20-007.....Large 8" Type (double cut)

CATALOG NO. 20-008.....Small 7" Type (double cut)

CATALOG NO. 20-009.....9½" Single End Type (double cut)

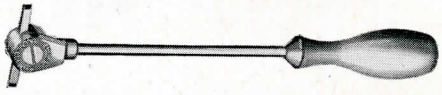
IDEAL Slotting Files are specially designed for commutator use. They are made of very hard steel for fast cutting action and long life. Proper tapers and curves allow for the rocking motion so desirable in this work.

No. 20-012 File is a straight type (double cut) which allows it to be used on three edges.

File No. 20-013 (double cut) has a narrow, knife-like edge for a quick start at undercutting a slot. It is particularly adapted for slotting mica of very small commutators, such as those of the hand tool class and other fractional horsepower D.C. or Universal motors.

NOTE—the curved files are made in three sizes—small double end 7" long, large, 8" long and single end. The single end file is fitted with a wooden handle. Weight approximately 10 oz.

HAND TYPE SLOTTER AND SCRAPER



A new and improved Hand Type Tool for cleaning slots, for smoothing burrs on copper segments and for removing mica fins and bevelling the sharp edges of copper after undercutting.

Can be used for undercutting commutator mica in small shops where only a few small motors are repaired.

The head of the tool is circular with a swiveled joint for setting the angle of the bit to the most convenient working position. Interlocking notches in the opposite faces of the head hold the bit perfectly rigid. It can be worked into close corners and in close to the radial risers of commutators.

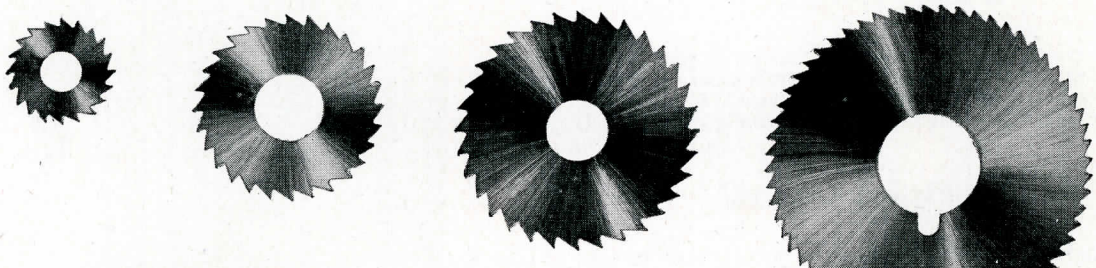
The specially hardened tool-steel bit is sharpened for "V" cutting at one end and designed for "U" cutting at the other. The large ball handle provides an easy grip for straight and accurate cutting. All of the parts except the bit are nickel plated.

CATALOG NO. 20-006.....Length 11", weight 1 lb.

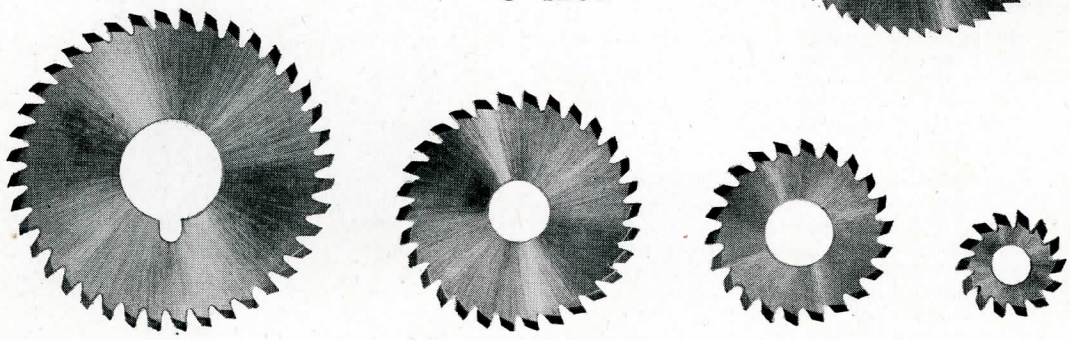
See Hints and Tables, Pages 71 to 88

COMMUTATOR SAWS and MILLING CUTTERS

Special No. 1 High Speed Steel



"U" SLOT



"V" SLOT-CHIP

CIRCULARS SAWS

("U" SLOT)

Standard Thickness (all sizes)—
.015, .018, .020, .023, .025, .028, .030, .033, .035, .038, .040, .043 .045 .050.

No.	Out. Diam.	Hole Size
1	¼″	⅛″
2	9/32″	⅛″
29	5/16″	⅛″
3	⅜″	3/16″
4	23/32″	3/16″
9	23/32″	5/16″
10	⅞″	5/16″
6	1″	9/32″
32	1″	⅜″
7	1⅛″	9/32″
8	1¼″	9/32″
27	1¼″	5/16″
14	1½″	15/32″

MILLING CUTTERS

("V" Slot-Chip)

50° Standard—Available also in 40°, 60° or other angles. One thickness only—.045″.

No.	Out. Diam.	Hole Size
30	½″	3/16″
31	23/32″	3/16″
19	23/32″	5/16″
20	⅞″	5/16″
16	1″	9/32″
33	1″	⅜″
17	1⅛″	9/32″
18	1¼″	9/32″
28	1¼″	5/16″
24	1½″	15/32″

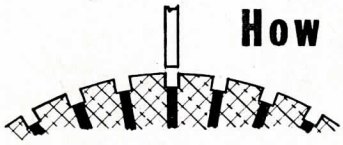
Extra Long Life

IDEAL "long-life" special No. 1 High-Speed Steel Circular Saws and Milling Cutters have been developed after years of experimenting and testing. The remarkable long life and sustained cutting efficiency of these Saws have convinced users that they are different than anything else on the market—cut faster and better.

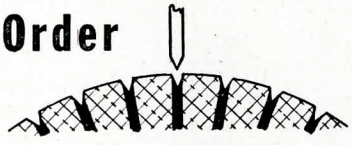
Regardless of the type of Mica Undercutter, IDEAL No. 1 High Speed Steel Saws can be supplied to give higher efficiency at lower costs.

Made by a new process, IDEAL Saws and Milling Cutters cut faster! They outlast ordinary saws FOUR TIMES—and even more in many cases. The more popular saws shown in table at left are carried in stock. Other sizes and special types available on special order.

How To Order



"U" SLOT



"V" SLOT-CHIP

When ordering, specify type wanted—hole size, outside diameter and thickness of saws.

The "V" slot Milling Cutters are made in one thickness only—.045″ thick. Because of the "V" shape of the teeth, this one thickness is suitable for cutting all thicknesses of mica ranging from .015″ to .045″.

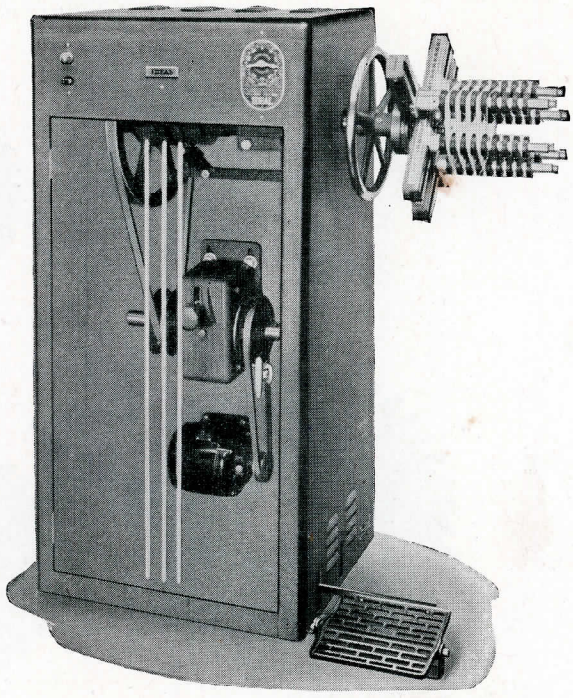
If you want an exact duplicate in No. 1 High Speed Steel of saw or cutter you have been using, please send sample. NOTE: IDEAL Saws and Milling Cutters are intended for cutting commutator mica only. They are not generally recommended for slitting copper and other metals.

See Hints and Tables, Pages 71 to 88

COIL WINDER DRIVE

For Use With All IDEAL Coil Winder Heads

Modern in every detail—the IDEAL Coil Winder Drive is made for quality winding of a wide variety of types and sizes of coils. Assures uniformly wound and perfect coils as constant wire tension is automatically maintained.



Positive Speed Control

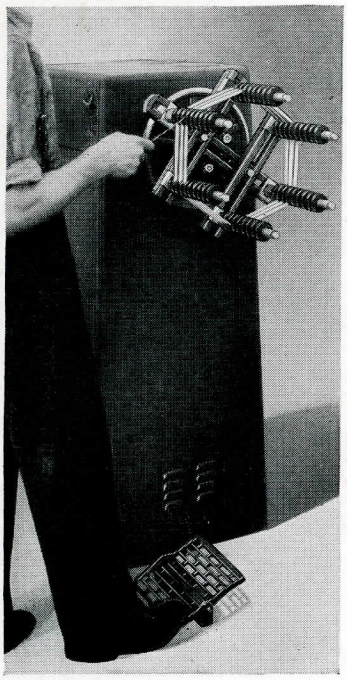
The maximum speed for any winding job is fixed by adjusting the control lever of the IDEAL "Select-O-Speed" Transmission.

While running, the speed is readily changed by raising or lowering the large foot pedal, thus obtaining the exact speed best suited to the immediate work. The pedal operates a cone type combination brake and clutch, which makes it possible to obtain any speed from 0 up to the maximum speed setting.

The maximum speed may be infinitely varied by adjusting the IDEAL "Select-O-Speed" Transmission. The "Select-O-Speed" has a wide speed ratio, so that the maximum speed may be set at any speed between 120 and 500 r.p.m. This variable adjustment speeds the winding of similar coils, because all guess-work is eliminated—the winding may be started slowly through the foot pedal and then brought up to the same maximum speed—each time.

When the operator's foot is removed from the pedal, a spring actuated brake automatically engages, and thus the winding tension of the wire is maintained.

The foot control pedal is also provided with a neutral position which allows the operator to turn the coil by means of a handwheel. This is a most desirable feature when winding multiple tap coils or armatures.



IDEAL Coil Winder Drive with IDEAL "Universal" Coil Winding Head. The IDEAL combination for winding series of six diamond coils (illustrated) and many other types and sizes.

Counter Records Turns

An IDEAL Revolution Counter in full view of the operator, records every turn of the machine. This Counter is of the direct drive type and thus indicates only the exact number of turns on the coil being wound. A Pilot Light provided on the front of the cabinet indicates when the motor is running.

The motor switch is mounted on the face of the cabinet. This is not only convenient, but also aids in the economic operation of the unit. The motor can be conveniently started and stopped during periodic operations. The Drive is totally enclosed, in a rigidly constructed heavy gauge steel cabinet. The winding head shaft is mounted on sealed ball bearings which are lubricated for life. Modern streamlining with blue wrinkle finish provides outstanding appearance.

Specifications

Capacity: Winding head shaft speed range is 90 to 500 revolutions per minute. *Output torque:* 350 to 60 in. lbs. (depending upon speed). The size of wire which can be wound depends upon the size and type of wire, size of coil and speed at which coil is wound (RPM of winding head shaft). Generally No. 10 wire or equivalent is considered maximum. Motor is ½ HP, 1750 r.p.m.

Dimensions: Floor space required, 18 in. x 24 in.; height (overall), 48 in.; winding head shaft above floor, 39½ in.; weight, 340 lbs. (Formerly Catalog No. 210).

CATALOG NO. 15-001 ..... 115 v, 60 cy.

CATALOG NO. 15-002 ..... 115 v, 25 cy.

NOTE: When Drive is ordered with motor other than above—either AC or DC—no starting equipment is supplied.

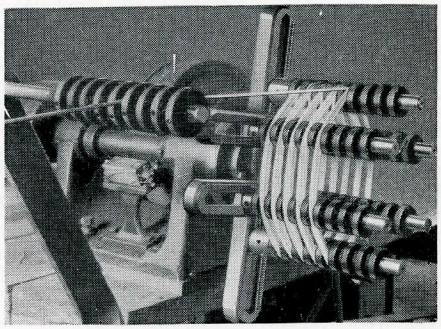
See Hints and Tables, Pages 71 to 88

COIL WINDER HEADS

Make Many Types of Coils—Field, Mush, Armature, Transformer, Motor Coils and Loops with Diamond, Round, Square or Rectangular Cores

SPEED WINDING! Eliminate the building and storing of many wooden forms which split, wear down on corners, warp or break and require a large amount of storage space. IDEAL Coil Winder Heads are adjustable, one model making many types and sizes of coils.

Readily mount on the IDEAL Coil Winder Drive, on the face plate of a lathe head or other turning device. After a little practice, an inexperienced worker can wind accurate quality coils—quickly.



Series of 6 Diamond Coils being wound on spindles of IDEAL "Universal" Model.

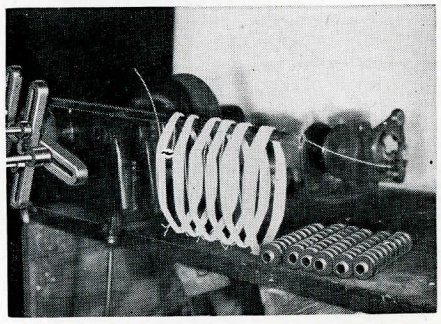
Pay For Themselves

Winding costs are cut so low when using IDEAL Coil Winding Equipment that the savings on just a few jobs will pay for a Winder Head. As an example, one user reports that the Armature Winding Head paid for itself on the first six jobs.

The armatures wound were 600 volts, 130 turns per coil, and 3 coils per slot, or a total of 390 turns of No. 34 wire. *Old-fashioned methods required a man 11 hours* to complete one armature, including stripping, cutting insulation, slotting, rewinding, baking, turning and testing.

With the IDEAL Armature Winding Head this same job was done in *only 6 hours—a saving of 5 hours per armature.*

Similar savings in time, work and cost can be made with IDEAL Armature, Stator and Coil Winder Heads on fractional horsepower, as well as on larger winding jobs.



Spindles removed, coils taped and finished. Approximately 10 minutes for the complete job.

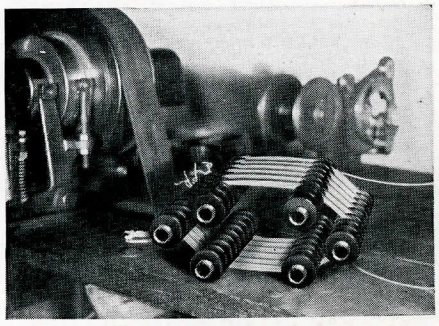
Adjustable—Easily Set Up

When making coils the Winding Heads are adjustable for different sizes and shapes. Quick changeover can be made from one size and shape to another. It is not necessary to have individual jigs and forms for each coil. Self-reading scales right on the Winding Heads permit rapid setting of spindles to proper size.

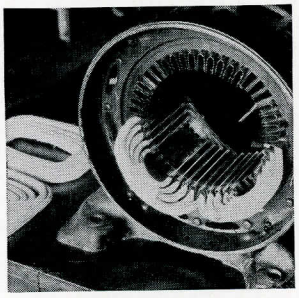
No soldering! A complete set of coils can be wound with one wire, thus eliminating the necessity of soldering coils in series. Wires in each set of coils are parallel, wound to correct shape, ready for insertion in motor, for example, without reforming or shaping.

As there are no side walls, coils can be laced, taped or tied before removal from head and are held true to form and shape. Sleeves and finished coils can be instantly removed from spindles with a quick jerk, leaving perfectly formed coils ready to be set in place.

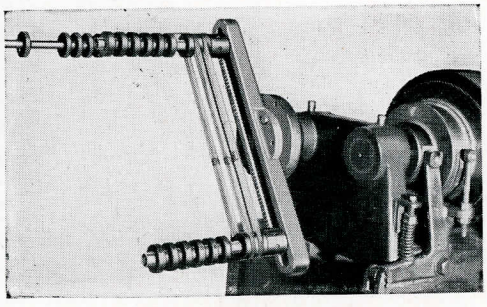
Obviously, IDEAL Coil and Armature Winder Heads should be used for all coil winding work. First cost is low. They are capable of handling a wide range of work at high speeds. After paying for themselves, they continue to earn dividends thereafter.



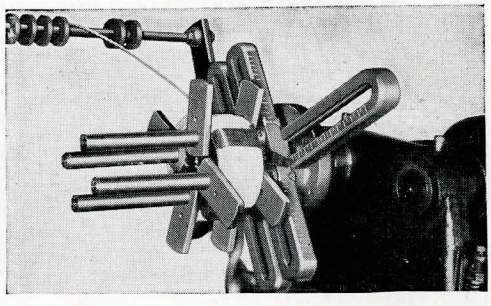
Coils wound, spindles removed. All 6 coils connected in series with one wire.



Coils wound on "Concentric" Model being inserted in motor.



Loops of from 2⅞" to 16½" can be made of rectangular wire.



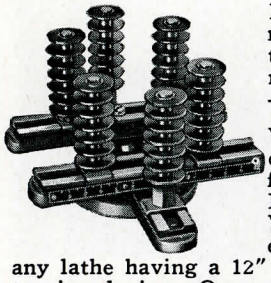
Field coils are wound quickly on either "Midget" or "Universal" Model.

See Hints and Tables, Pages 71 to 88

COIL WINDER HEADS

"MIDGET" MODEL

Winds Coils Up to 6½"x8½"



Makes many types of coils—field, mush, armature, transformer, motor coils and loops with diamond, round, square or rectangular cores —from 4" x 1¾" to 6½ x 8½".

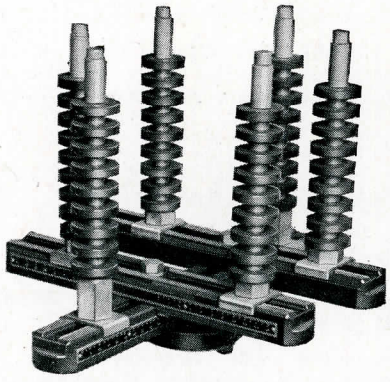
Winds small coils in all phases of electrical work. Ideal for winding field coils in automotive work. Easy to mount on IDEAL Coil Winder Drive. Can also be mounted and used on the face plate of any lathe having a 12" swing or larger, or on any other turning device. On smaller lathes, it may be attached to the outer end of the head stock spindle; shaft through hole in spindle carries Coil Winder Head and is driven by gripping in lathe chuck on opposite end. Sturdy construction, extreme flexibility and ease of adjustment are all incorporated in this winding head. A perfect mate for the "Universal" Model.

Has six spaces on the spindles for coils. Open construction allows the operator to wind all six coils in series, thereby eliminating the necessity of soldering and taping joints. Coils may be taped and tied together ready to be placed in the armature or stator slots before they are removed from the head. Furnished complete with 6 field coil spools and one extra spool to use as a wire guide. Weight 10 lbs.

CATALOG NO. 16-002 (Formerly No. 5)

"UNIVERSAL" MODEL

Winds Coils Up to 13"x16½"



Flexible — winds from 40 to 60 perfect coils per hour ranging in size from 3⅛" x 6½" up to 13" x 16½". Easily winds many types and sizes of armature, field, transformer, motor coils, etc. Coils are wound from one wire—no soldering.

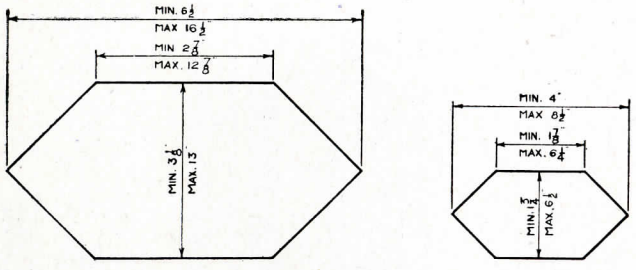
The complete IDEAL "Universal" Coil Winder Head is as shown with machined base for mounting on the IDEAL Coil Winder Drive. Also easily mounted on face-plate of lathe having 20" swing or larger, or other turning device. Six adjustable spindles are mounted on the Coil Winder Head, each with removable sleeves on which are mounted nine spacing washers.

Nine extra spacing washers are supplied for mounting on a ¾" rod or tube which should be mounted parallel with the spindles on the head. These serve to guide the wires in winding onto the spindles in even layers.

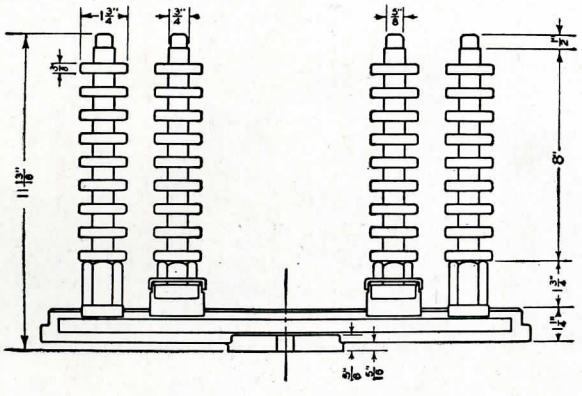
There are also furnished eight side wall retainers which are intended for winding deep coils such as field coils, transformer coils or solenoids.

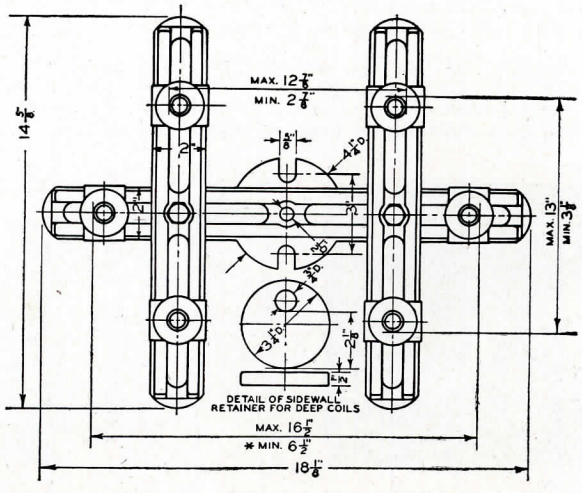
All parts are sturdily constructed and accurately made so that exact duplicate coils may be wound. Scales on the cross arms make it easy to accurately set up for different size and shape coils. Weight complete 30 lbs.

CATALOG NO. 16-001—(Formerly No. 10).



Comparison in size between "Universal" Model (left) and "Midget" Model (right).



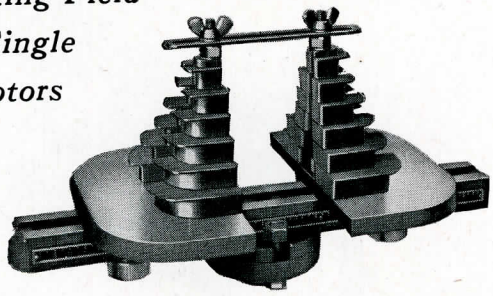


Dimension sketch showing "Universal" Model Coil Winder Head.

COIL WINDER HEADS

"CONCENTRIC" MODEL

For Winding Field Coils of Single Phase Motors



Simplifies the winding of popular size, single phase motor coils including refrigerator, oil burner, washing machine and similar motors. Easily adjustable for length and width of coil.

After winding, the forms telescope so that the entire group of coils may be removed at one time. Coils may be wound in gangs or groups up to six, with all coils connected in series—no soldering of ends.

The winding segments or forms are each separately adjustable lengthwise and transverse. After the segments are once set, they may be clamped together as a unit. Thus, to wind duplicate coils, it is only necessary to move the two units when removing the coils which greatly speeds up the winding operation. A scale on the base makes it easy to return the two units to the same position. Weight 20 lbs.

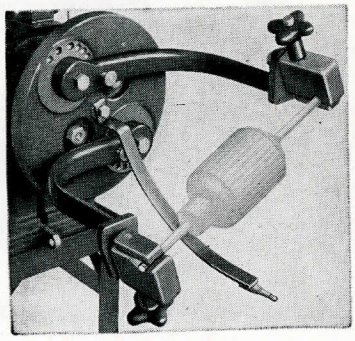
CATALOG NO. 16-005—*(Formerly No. 20)*

Tier No.	Max. (Inches) Length	Max. (Inches) Width	Min. (Inches) Length	Min. (Inches) Width	Radius (Inches)
1 (top)	7 1/8	3/4	1 1/4	3/4	1/4
2	7 5/8	1 1/2	1 3/4	1 1/4	1/4
3	8 1/8	2 3/8	2 1/4	1 7/8	1/2
4	8 7/8	3 5/8	3	2 5/16	3/4
5	9 5/8	5	3 3/4	2 7/8	1
6	10 3/8	6 3/4	4 1/2	3 3/8	1 1/4
7 (bottom)	11 1/8	8 3/4	5 1/4	3 7/8	1 1/2

The maximum length of coil No. 1 may be increased to 10 1/8", No. 2 to 10 5/8", No. 3 to 11 1/8", No. 4 to 11 7/8", No. 5 to 12 5/8", No. 6 to 13 3/8" and No. 7 to 14".

ARMATURE WINDING YOKE

For Winding Medium Size Armatures



A handy device for winding any type of armature from 9" to 19" in length. The wires are guided into the slot by hand. May be used on the IDEAL Coil Winder Drive or on an ordinary lathe. Assures neater and faster armature winding than other methods.

Consists of two cast iron arms fastened to a round cast iron mounting base. May be adjusted to increase or decrease the amount of span of the yoke by merely swinging the arms toward or away from the center. Each arm has an indexing pin which can be placed in corresponding holes on the mounting base, which assures centering of the work. There are nine index holes for each arm giving nine equal spaces from 9" to 19" (see sketch).

Jaws for clamping the armature are mounted on the outermost end of each arm. A half turn of the locking knob clamps or releases the armature, enabling the operator to quickly insert or remove it from the yoke. The armature may be rotated in the jaws while clamped in position. Net weight 28 lbs.

CATALOG NO. 16-004—*(Formerly No. 4)*

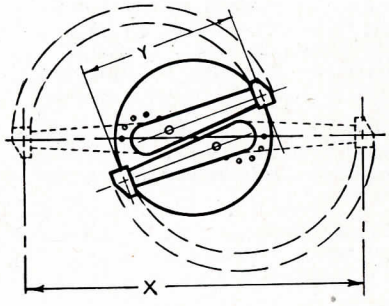
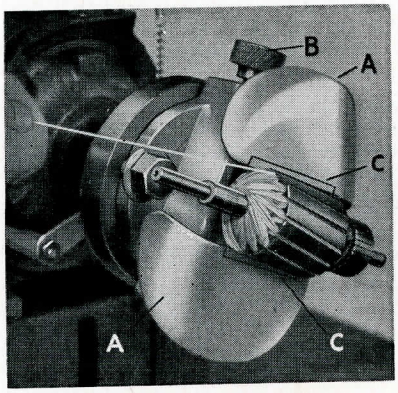


Diagram shows how arms may be moved in nine (9) different positions for handling armatures with shafts from 9" to 19" in length.



ARMATURE WINDING HEAD

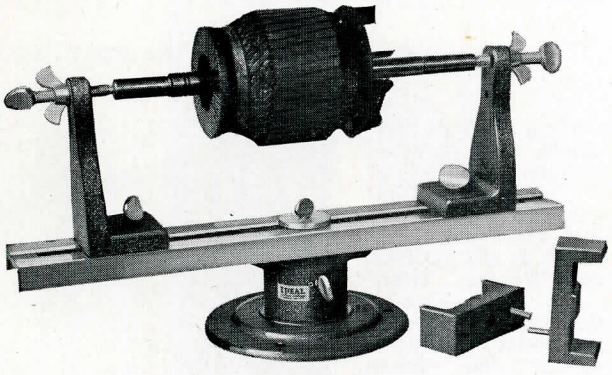
For Winding Small Armatures

Easy to set up. Simplifies the winding of small universal, two pole DC, or repulsion induction motor armatures. Adjustable to accommodate armatures up to 3" in diameter with 2 1/4" maximum armature stack.
The jaws are moved back and forth by simply turning a knurled adjusting knob (B). The jaws move in and are guided by milled ways. The wing jaws can be tilted to suit the skew of the slots. The jaws (CC) are of chilled steel and are ground to a sharp edge. Thus, when an armature is clamped in the head, the slots are held flush with the edge of the jaws. After clamping the armature in place, an adjustable stop may be set behind the armature making it easy to turn to the next pair of slots. Weight 2 lbs.

CATALOG NO. 16-003 *(formerly No. 2)*

See Hints and Tables, Pages 71 to 88

ARMATURE AND STATOR HOLDER



Rotates on Ball Bearing . . . To Most Convenient Working Position

Conveniently holds any size fractional HP armature or stator while soldering commutator leads, inserting insulation and wedges, banding armatures, rewinding, removing and inserting coils, etc.

The base is made in two sections—(1) the lower or stationary part that fastens to a bench top—(2) the upper portion of the base which supports the cross arms for the upright castings. The upper section pivots on the stationary part and freely rotates, permitting the work to be turned to the most desirable position. A thumb screw locks the rotating member to the stationary base.

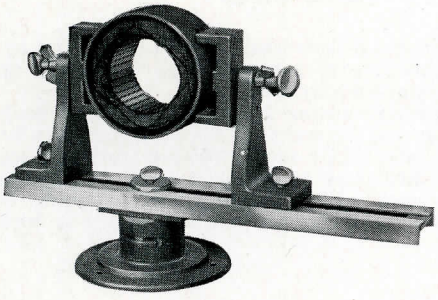
Easy To Adjust

Each upright casting is equipped with a malleable iron thumb screw, the ends of which are machined to a center taper to receive the centers of an armature shaft. Armatures are held by turning these screws into the shaft centers and locking in place with lock nuts. The angle iron cross-arms can be shifted on the base by loosening a thumb screw.

Two adaptors made of cast iron are supplied for holding stators. They are mounted on the upright end castings in almost the same manner that copper jaws are mounted on a regular machinist's vice.

Overall length 22", overall height 12½". Maximum length of armature shaft which can be suspended is 18". Maximum diameter of stator which can be held is 12". Weight, 40 lbs.

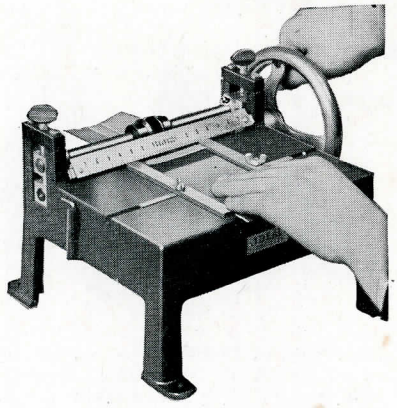
CATALOG NO. 16-006—*(Formerly No. 12)*



Holding Stator. Simple adjustments make it easy to turn work to any desirable position. Eliminates makeshift equipment.

INSULATION FORMER

Forms Slot Insulation up to 8" Wide . . . Any Length

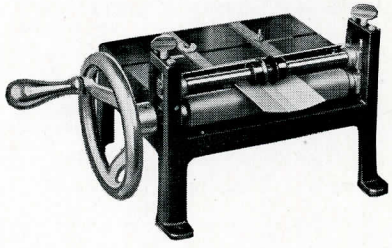


FOR PLAIN OR CUFFED INSULATION.

All the slot insulation needed for any job can be quickly turned out with a few turns of the crank. Insures neat fitting and uniform slot lining which speeds up winding, and prevents burned out armatures caused by lining being torn when coils are tamped into place.

No Damage Or Waste

Insulation is accurately guided between the rubber roller and two creasing rollers by two brackets. The rubber



roller protects the insulation and prevents the creasing rollers from cutting through. A ruler guide makes it easy to set the creasing rollers and guide brackets for any particular slot.

Simple To Set Up

All adjustments are made with thumb screws except the creasing rollers which have Allen head set screws. Any desired width of trough, up to 1½", may be obtained by adjusting the span between the two hardened steel creasing rollers.

The creasing roller assembly is adjustable on the shaft so that the trough may be formed at any desired position. Pressure between creasing rollers and rubber roller to allow for thickness of insulation, is varied by the thumb screw on each bracket supporting the creasing roller shaft.

For production purposes the hand wheel may be removed and the roller driven by a small electric motor. Guide brackets are adjustable to 8" maximum width. Weight, 16½ lbs.

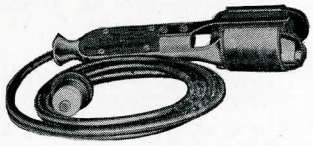
CATALOG NO. 40-001—*(Formerly No. 10)*

GROWLERS

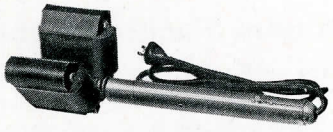
For Locating "Shorts", "Grounds" and "Opens"

Short Circuit Test

The most common way of testing for "shorts" is the so-called feeler method in which the feeler is a hack-saw blade, or a piece of soft iron of about the same size. With the Growler spanning or straddling one side of the coil, the feeler is held over the slot bearing the other side of the same coil (Fig. 1). If the coil is short circuited, *the feeler will stick and vibrate* and also change the tone or hum of the Growler.



Type "F" Growler (with built-in feeler) for both armatures and stators up to 50 H.P. Best range is from 1/10 H.P. to 15 H.P.



Type U-2 Adjustable Growler for both armatures and stators. Available with meter.

Where the Growler has a meter to measure current in the primary circuit, a deflection of the needle indicates when a short circuited coil is passed over.

Open Circuit Test

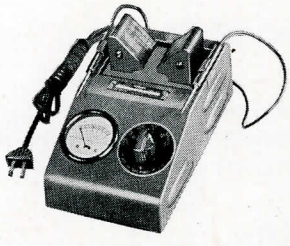
Open circuits usually can be detected with any of the Growlers by short circuiting the end of the coil or coils spanned by the Growler. On the armature this may be done quickly by successively short circuiting adjacent commutator bars and on stator by short circuiting adjacent lead wires. If no spark is obtained, the coil is open. Type "S" Growlers with test prod and meter simplify this test. When adjacent bars or coil ends are touched with the test prods, the meter will indicate the voltage induced between those ends, thus giving a check on correct number of coil turns as well as coil continuity.

Ground Test

Only the Type "S" Growlers with test prods and meter can be used for testing "grounds." With the armature placed on the Growler, successive bars are touched with one test prod, while the other is held on the metal core. A deflection of the meter indicates a "grounded" coil.

Description

Type	Cat. No.	Range for Armatures	Range for Strators	Weight Lbs.
S-OM	39-018	½" to 4"		6
S-1	39-035	2" to 8"		10
S-1M	39-022	2" to 8"		10
S-2	39-007	4" to 16"		16
S-2M	39-010	4" to 16"		16
U-2	39-013	2" and up	5¾" & up	20
F	39-016	6" to 12"	2½" to 12"	5



Type S-1M Growler with meter. Types S-0M and S-2M of similar design except that S-2M meter is in separate case.

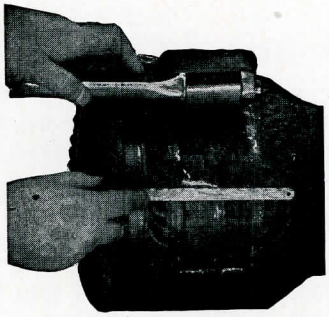
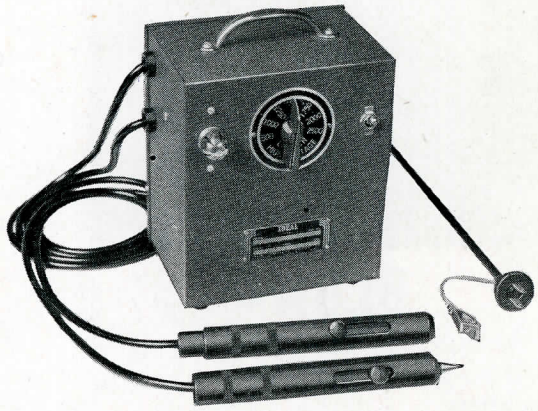


Fig. 1—Using Type "F" Growler to test for "shorts" on 5 H.P. armature.

INSULATION TESTER

Detects "Grounds", "Shorts", "Broken Wires"



The IDEAL Insulation Tester quickly indicates the presence of "shorts," "grounds" and broken wires in low voltage equipment, such as motors, transformers, etc.

Tests Up To 2,500 Volts

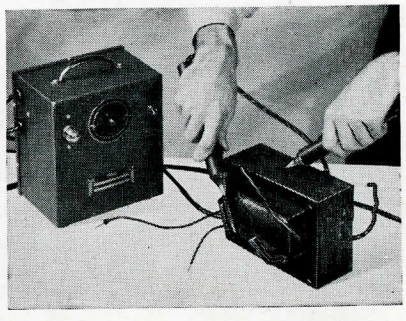
A turn of the dial quickly gives a choice of any one of seven voltages—500, 1000, 1250, 1500, 1750, 2000, or 2500 volts. *To test for "shorts"*, for example, between the primary and secondary winding, it is only necessary to set the dial to the desired test voltage and touch one test point to the end of each coil. If there is a "short", the red indicating lamp goes out immediately.

To test for "grounds", one test point is touched to the coil and the other to the frame of the transformer or machine. The N.E.M.A. recommendation for the insulation test on motors and generators is twice normal voltage plus 1000 volts. Since the IDEAL Insulation Tester has a capacity up to 2500 volts it readily accommodates average requirements.

The transformer has a high leakage reactance which limits the current to a safe value in case of a shorted winding. It has ample capacity to supply the charging current involved in testing large motors or transformers. This prevents a high voltage drop, which might otherwise give a false test or indication.

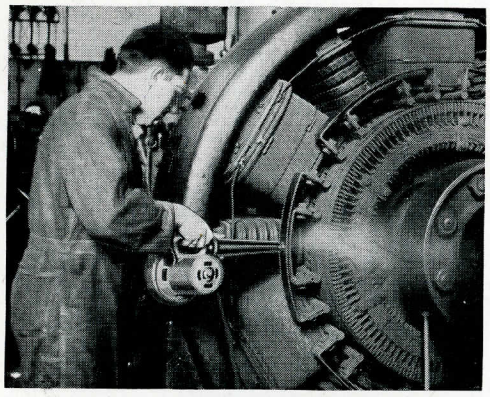
Safe

Operates from any electrical outlet. All current carrying parts are fully and carefully insulated, making the IDEAL Tester safe to operate. Spring operated safety sleeves over the test points, which can only be bared by pressing the buttons forward on side of handles. Has three wire safety type cord. Rating 600 volt amp. (maximum). Weight 18 lbs. *(Formerly Catalog No. 36).*



CATALOG NO. 41-001.....115 v, 50-60 cy.
CATALOG NO. 41-003.....230 v, 50-60 cy.
CATALOG NO. 41-002.....115 v, 25 cy.
CATALOG NO. 41-004.....230 v, 25 cy.

See Hints and Tables, Pages 71 to 88

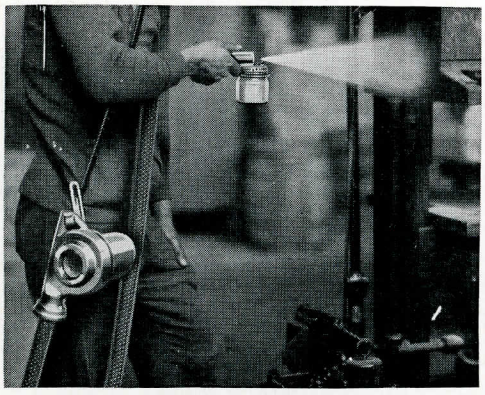


BLOW—

Blow out grit, dust and lint from hard-to-get-at places. Evaporate moisture.

VACUUM—

Clean up dirt, metal, lint and small particles, bench litter, etc.



SPRAY—

Paint, varnish, lacquer, insecticides and deodorants.

IDEAL "3-in-1" Electric Blowers and Cleaners Provide the Best and Easiest Way to Machine and Plant Cleanliness.

Dust, dirt, lint, metal and other particles from materials used in production cost industry millions of dollars yearly as it settles around machinery, motors, generators, electrical apparatus, production materials and finished products, on pipes and overhead feeds, in floor cracks, elevators, under stairs, closets, etc. No plant can be free from "dustruction" unless *"good housekeeping"* measures are practiced regularly.

Eliminate Machinery and Plant Hazards

Dust Fires are particularly common since dust is prevalent in process manufacturing. The fire is really caused by an explosion, resulting from dust mixed with air in proper proportions and ignited—ignited by even a spark from a light switch or from a motor commutator.

Short Circuits in motors are often caused by dirt accumulations which become damp and thus are conductors of electricity. *Burned out bearings* in machines and motors are many times caused by dirt and grit which finds its way into the bearings and acts as abrasive.

All these and other results of "dustruction" are easily and quickly conquered with powerful IDEAL "3-in-1" Portable Cleaners. There's no better, lower cost way to good *housekeeping*.

Cut Cleaning Costs Up To 80%

IDEAL Portable Cleaners *vacuum—blow—spray*. They reach into every crack and crevice and clean away all dust, grit, metal particles and dirt accumulation.

IDEAL Portable Cleaners are flexible and easily adaptable to all kinds of cleaning work! Cleaning by vacuuming is preferred, for then dust and dirt are permanently removed. However, some places are inaccessible to vacuuming and must be blown clean. IDEAL Cleaners are easily converted into blowers and vice versa. They are used for all general plant cleaning jobs as well as for spraying insecticides, deodorants, varnish, shellacs, paint, etc.

No Oil, No Condensation, No Excessive Pressure

IDEAL Cleaners blow only *dry* air, free from the condensed moisture which accumulates in compressed air systems. They deliver a large volume of air at high velocity, yet low pressure. High velocity gives adequate cleaning action, while the low pressure eliminates any possibility of damage to delicate equipment or adjustments.

Attachments Available For All Cleaning Purposes

A wide selection of "Hand" Models and Portable "Tank Type" Cleaners, together with many Attachments, make it easy to select the right IDEAL Cleaner combinations for every job in every plant.

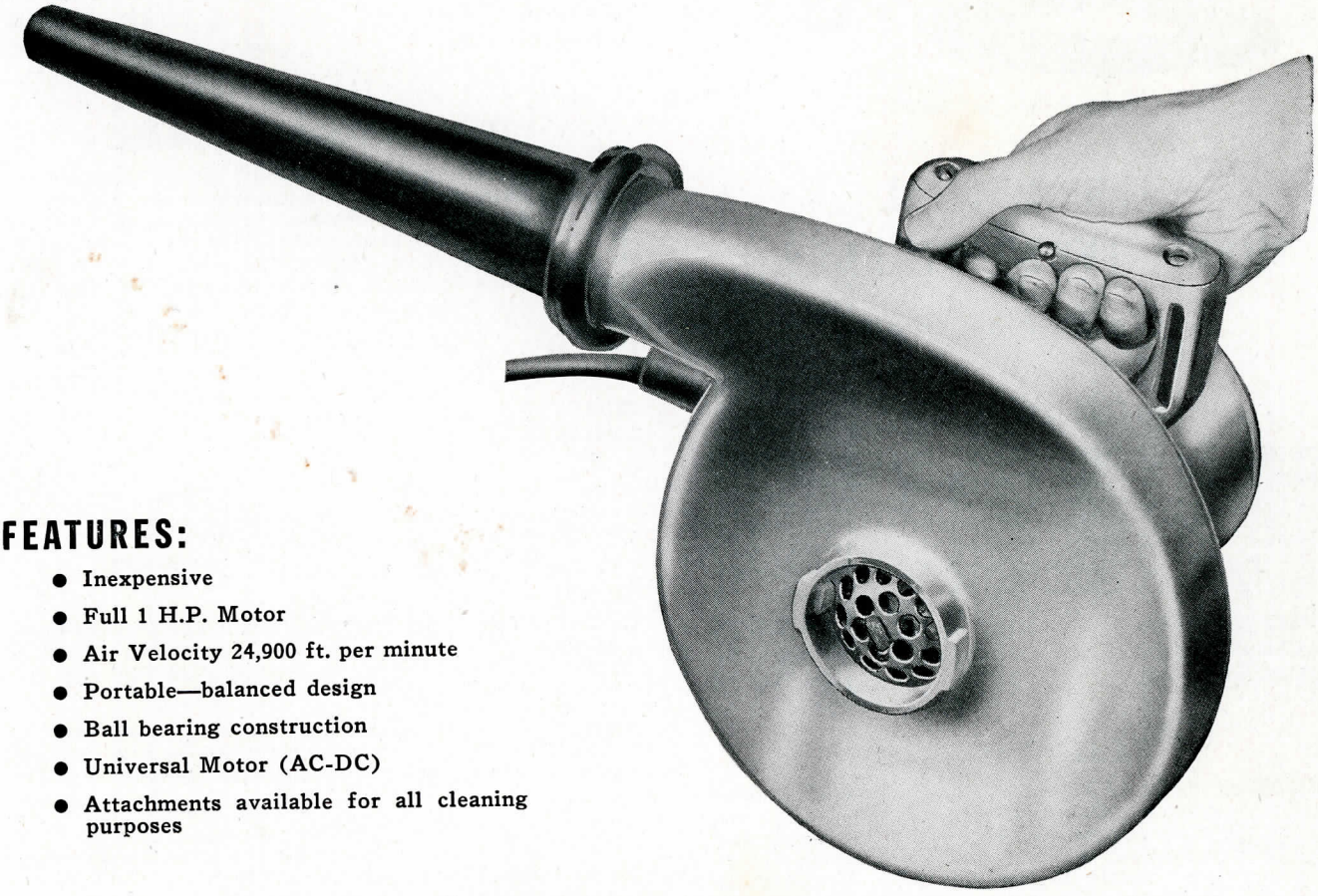
Thousands In Use

Factories, mills, machine shops, ship yards, mines, utilities, railroads, etc., use IDEAL Blowers and Cleaners daily to prevent motor burnouts, fire and health hazards. You, too, can avoid costly maintenance bills the IDEAL way.

Super-Powered "JUMBO" MODEL

Most Powerful Hand Cleaner Made!

HAS FULL 1 H.P. MOTOR



FEATURES:

- Inexpensive
- Full 1 H.P. Motor
- Air Velocity 24,900 ft. per minute
- Portable—balanced design
- Ball bearing construction
- Universal Motor (AC-DC)
- Attachments available for all cleaning purposes

BLOW—VACUUM—SPRAY!

HAS NO EQUAL! Equipped with a full 1 H.P. motor that turns at 12,200 R.P.M. and gives a blower velocity of 24,900 ft. per minute. The static pressure (waterlift) with discharge outlet closed is 49"—plenty of power for cleaning inside of and behind machinery, and other out-of-the-way places. Blows dry air at low pressure—*will not harm delicate equipment.*

Non-Destructive

The "Jumbo" is not a substitute, it is decidedly better and more efficient than compressed air or truck type cleaners. The air stream does not contain harmful moisture or destructive pressure found in all compressed air systems.

Its sustained VOLUME of clean, dry air cleans safely—dry air won't harm or rot out electrical insulation, wire connections or delicate parts. The "Jumbo" too, because of its extreme portability, reaches places impossible to reach with a normal length hose on truck-type machines or compressed air.

In addition to the standard suction and spraying attachments, many special attachments are available with the "Jumbo" making it ready for any plant cleaning job. Workmen like to use this Cleaner, for they can see where they clean—leaves everything "spic and span" and solves the problem of *good housekeeping.* Attachments are easily connected and interchanged.

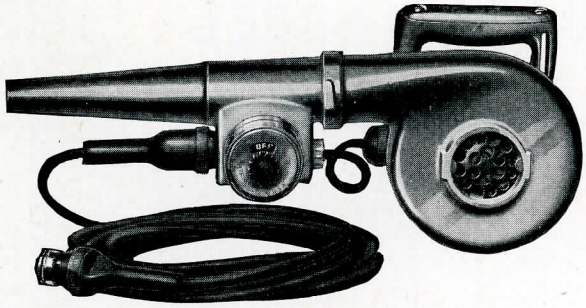
Description

The "Jumbo" Cleaner is a completely enclosed unit, very portable and balanced for easy handling. Has full 1 H.P. motor, 12,200 RPM; precision type ball bearings—no oiling necessary; air volume discharge—76.5 cu. ft. per minute; air velocity discharge—24,900 ft. per min.; waterlift 49"; diameter of discharge outlet—¾"; overall size with blower nozzle 21 in. x 9 in. x 9 in.

Equipped with 20 ft. heavy duty cord and plug; motor is universal type, operates from AC or DC—(722 watts). Shipping weight 18 lbs. *(Formerly No. 50).*

CATALOG NO. 22-013.....115 v, AC-DC
CATALOG NO. 22-014.....230 v, AC-DC
CATALOG NO. 22-015.....250 v, AC-DC

See Hints and Tables, Pages 71 to 88



"Hot and Cold Air" Model

OTHER IDEAL "HAND TYPE" CLEANERS

All Models Blow Dry Air

"Super-Giant" Model

FOR HEAVY DUTY SERVICE. Sturdily constructed—high powered for years of service. Air velocity, 20,900 ft. per minute; waterlift 36.2″; air volume discharge 62 cu. ft. per minute. 3/5 HP universal motor, ball bearing construction. Overall size including blower nozzle 19½″x 8″x8″. *Complete Attachments available.* Shipping weight 14 lbs. (Formerly Catalog No. 30).

CATALOG NO. 22-009.....115 v, AC-DC
CATALOG NO. 22-011.....230 v, AC-DC
CATALOG NO. 22-012.....250 v, AC-DC

"Giant" Model

FOR INTERMEDIATE SERVICE. Meets all average cleaning conditions. Air velocity 17,300 ft. per min.; water lift 25.6″; air volume discharge 53 cu. ft. per min. Has 1/3 HP ball bearing, universal motor. Overall size including blower nozzle 18¼″x8¼″x7½″. *Complete attachments available.* Shipping weight 11 lbs. (Formerly Catalog No. 20).

CATALOG NO. 22-005.....115 v, AC-DC
CATALOG NO. 22-006..... 32 v, AC-DC
CATALOG NO. 22-007.....230 v, AC-DC
CATALOG NO. 22-008.....250 v, AC-DC

"Whiz" Model

Per Minute; Waterlift 20″; Air Velocity Discharge 46 FOR LIGHT DUTY WORK. Air Velocity 15,000 Ft. cu. ft. per minute; ¼ H.P. Universal Motor; Ball Bearing construction. Overall size, including blower nozzle, 18¼″x8¼″x7½″. *Complete Attachments available.* Shipping weight 10 lbs. (Formerly Catalog No. 10).

CATALOG NO. 22-001.....115 v, AC-DC
CATALOG NO. 22-003.....230 v, AC-DC
CATALOG NO. 22-004.....250 v, AC-DC

"Hot and Cold Air" Model

Same specifications as the "Giant" Model Cleaner, but equipped with a heating element and 3-way switch. A blast of hot air may be obtained at the turn of a switch. Especially good for places where the rapid removal of moisture is desired in conjunction with cleaning. The surest antidote for rust! Has 1/3 HP ball bearing, universal motor with three-way switch. Overall size 17″x 7″x8″. FOR BLOWING ONLY—no attachments available. Shipping weight 11 lbs. (Formerly Catalog No. 40).

CATALOG NO. 22-016.....115 v, AC-DC
CATALOG NO. 22-018.....230 v, AC-DC
CATALOG NO. 22-019.....250 v, AC-DC

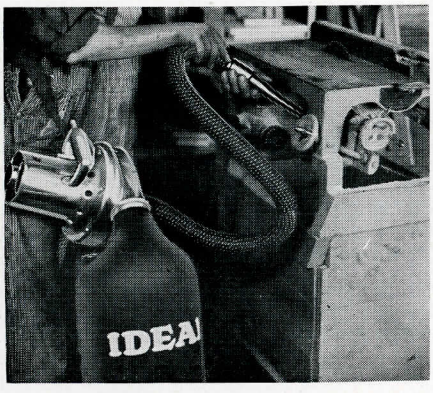
STOPS MOTOR BURNOUTS— PREVENTS SHUTDOWNS

Used as a blower, the IDEAL Cleaner removes the moisture from everything it touches—preventing shorts in motors, electrical wiring, etc.—preventing rust and corrosion to machine parts.

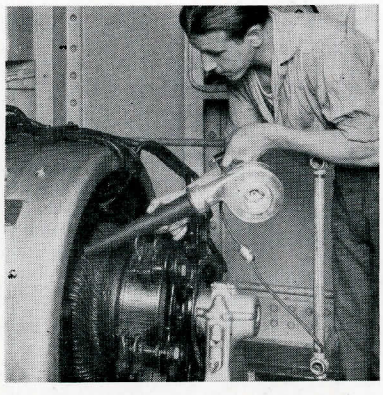
Aids production—a clean plant encourages workmen to take pride in doing their work right—helps stop carelessness and shiftlessness. *Clean-up means profits!*

The "Jumbo" and three other size Hand Blowers, described, plus the Portable Tank Models, pages 28 to 30, make it easy to select the proper cleaning combinations for any cleaning job. INEXPENSIVE—IDEAL Cleaners save their cost time and time again.

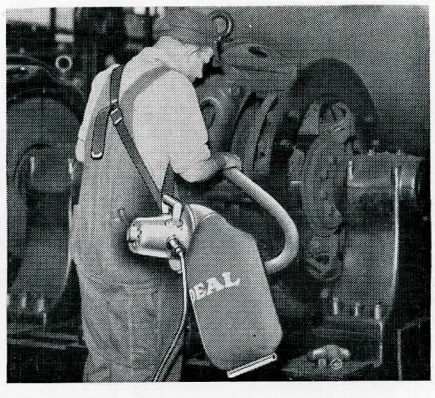
KEEPING MACHINERY CLEAN AS IMPORTANT AS GOOD LUBRICATION



Vacuuming saw dust from circular saw. Aids prevention of fires.



Blowing dirt and lint from electrical motor. Helps stop motor burn-outs.



Vacuuming dust from inaccessible places in motors and machinery protects investment.

STANDARD ATTACHMENTS

For Use With "Hand Type" Blowers

The attachments illustrated above are standard *vacuum* cleaning attachments for use with the "Jumbo," "Giant" and "Super-Giant" Model Blowers.

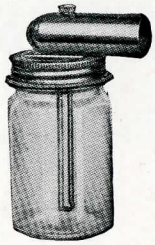
CATALOG NO. 22-104 includes:

NO. 22-082 Large Dust Proof Bag
NO. 22-081 Hose Connection
NO. 22-068 4'x1½" Rubber Covered Hose
NO. 22-031 6" Metal Nozzle
NO. 22-028 Flat Fibre Nozzle
NO. 22-043 Bristle Brush with clamp for 6" Nozzle
NO. 22-089 Shoulder Strap

See page 29 for special attachments. IDEAL offers the most comprehensive selection of suction and spraying attachments available—long tubes to reach high places, floor nozzles for office cleaning, special spraying parts, etc. These attachments increase the usefulness of IDEAL Cleaner manyfold. (See Page 29.)

See Page 29 for Other Attachments—
For All Cleaning Purposes!

POWDER AND LIQUID SPRAYER

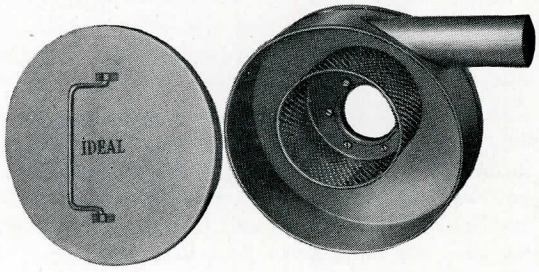


For spraying powder, liquid, insecticide, varnish, lacquer, calcimine, oil, etc. Fits on end of standard 4' hose. Available in quart or pint size. Weight 2 lbs.

NO. 22-084.....Quart size **NO. 22-085** .....Pint size

SCRAP KEEPER

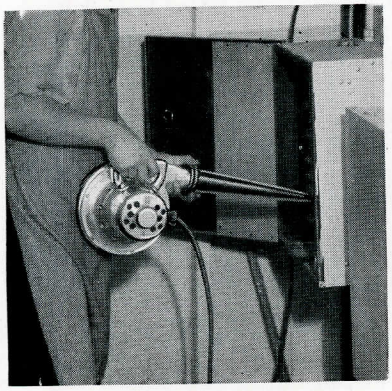
Easily Attached—Protects Fan and Housing



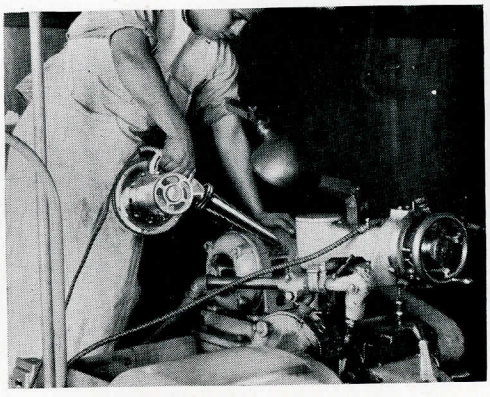
Catches and holds heavy metal particles, such as screws, nuts, nails, washers, etc. Protects fan and fan housing. Stops rapid bag wear. Separates all dust and dirt from scrap so that it may be inspected for things of value.

The "Scrap-Keeper" couples directly onto the fan housing while the suction hose is slipped over the intake throat. To empty, merely turn off Cleaner and remove cover. Fits all IDEAL "Hand Type" Cleaners. Net weight, 1¾ lbs.

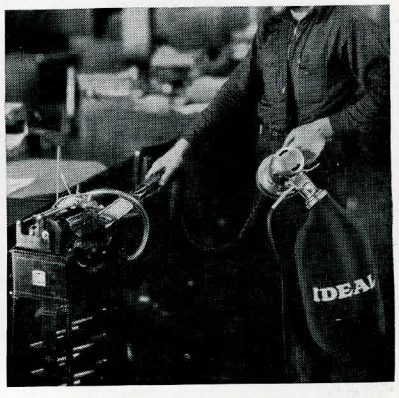
CATALOG NO. 22-090 When ordering for Cleaner now in service, advise inside diameter of hose.



Cleaning switchbox. Safe—prevents possible shock.



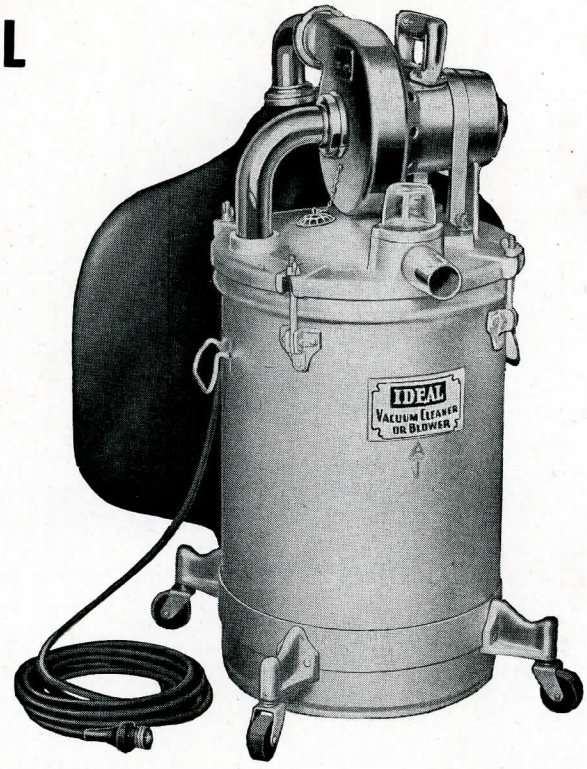
Cleaning Universal Grinder in machine shop.



Vacuum cleaning office dictaphone—takes dirt away!

INDUSTRIAL "TANK" MODEL

Compares to Cleaners Selling at Three to Four Times Its Cost



VACUUMS . . BLOWS . . SPRAYS

This cleaner has everything—plenty of power—full 1 HP Motor—light weight and compact size for easy portability. Available with many attachments for all cleaning purposes.

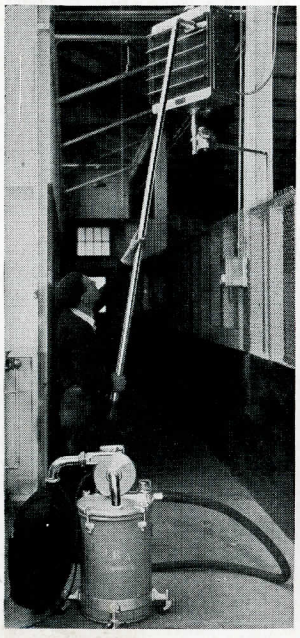
In addition to dust, dirt, lint and other light materials found in manufacturing, many plants have wastes of much heavier nature from production operations. For these jobs and many others, the unusually powerful IDEAL "Tank Type" Model has been developed. Not only will it pick up the heaviest dust and dirt, even if moist, but it will pick up small metal filings, turnings and scrap, small pieces of wood or other materials.

The IDEAL Tank Cleaner is so powerful that it picks up heavy pieces no cloth bag could hold. It is equipped with a metal tank in which the heavy materials are trapped, only the light dust penetrates to the cloth bag. This prevents damage, wear and tear to the suction fan, housing and bag and gives increased capacity. Tank holds 12 gallons.

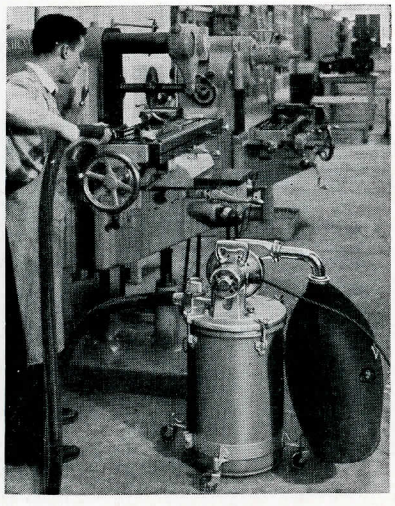
Power Unit Detachable

The Power Unit is detachable and can be used as a hand portable blower. Used as such, it develops a powerful blast of dry air that not only forces out dust, grit and metal particles, but also dries the moisture out of everything it touches.

Because of its tremendous power, the "Tank Type" Cleaner is used in many commercial buildings where ordinary household type cleaners do not work fast or effectively enough.



Vacuuming dirt and dust from unit heater.



Removing dirt and chips from milling machine.

Many Features

The tank is rust proof finished steel with 12 gallon capacity. It is readily opened for cleaning by simply removing the top which is held by four wing-nuts. Paper liners make the removal of dirt fast and clean. The tank is mounted on four large easy rolling casters, so that it can be readily moved to any desired spot. Overall dimensions approximately 24 in. x 24 in. x 32 in.

The power unit which is the same as the "Jumbo," has a 1 HP universal motor, ball bearing construction. As a blower only, it blows a blast of dry air at a velocity of 24,900 ft. per minute. As a vacuum cleaner, it handles 185 cubic feet of air per minute. Plenty of power to pick up heavy dirt, metal particles, etc. Has 20 ft. reinforced heavy duty rubber cord and plug. Complete attachments available as illustrated on page 29. Shipping weight 78 lbs. (Formerly Catalog No. 100).

NO. 22-020 ..... *115 v, AC-DC*
NO. 22-021 ..... *230 v, AC-DC*
NO. 22-022 ..... *250 v, AC-DC*

Guaranteed

ALL IDEAL Portable Electric Cleaners are unconditionally guaranteed for one year against defects. With care, should last a lifetime.

ATTACHMENTS FOR TANK AND PORTABLE CLEANERS

Standard Set of Industrial "Tank Type" Cleaner Attachments

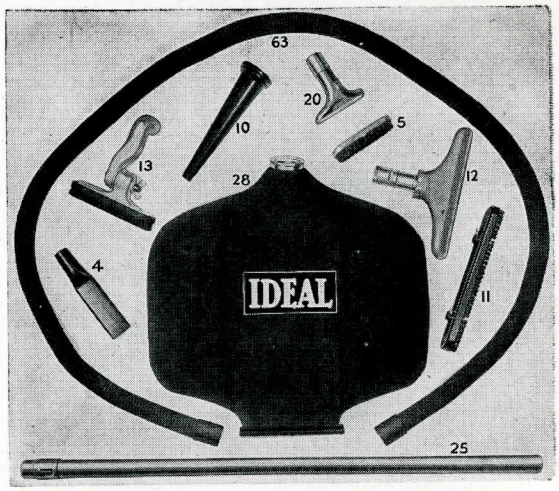
The Attachments pictured (right) and listed below, will take care of practically every ordinary cleaning job. When purchasing an IDEAL Industrial "Tank-Type" Cleaner, it is recommended that this set of Standard Attachments be purchased, together with any other Special Attachments that might be desired for any particular cleaning job. Order by **CATALOG NO. 22-103**

Illust. No.

28A Large Dust-Proof Bag
4 Flat Fibre Nozzle
10 Rubber Blowing Nozzle
20 5" Metal Nozzle for general cleaning
5 6" Brush for 5" Nozzle
— 10' x 1½" Flexible Rubber Covered Hose with Swivel Sleeve

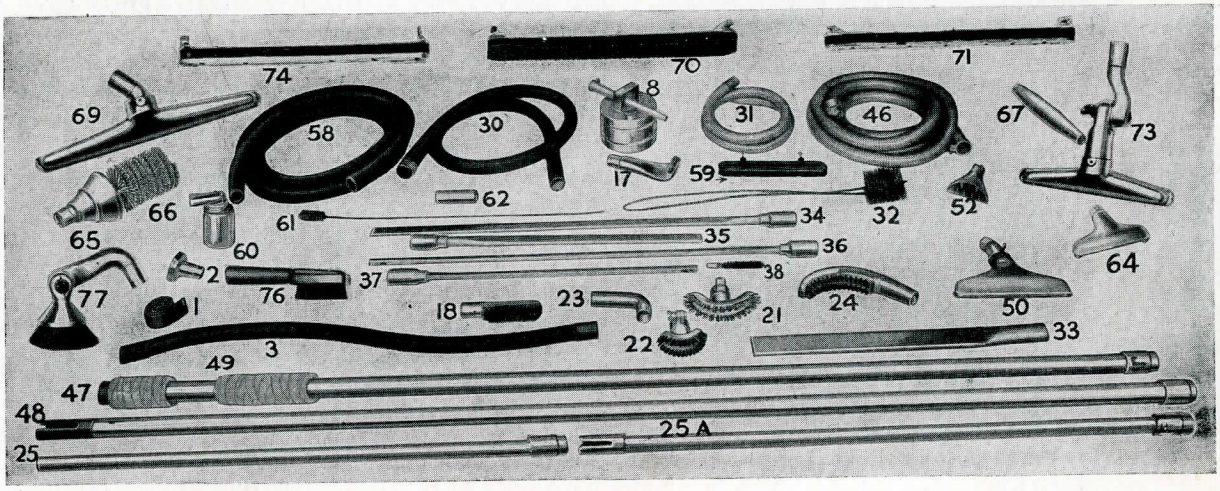
Illust. No.

13 Adjustable 8" Wall Brush
12 12" Wide Floor Nozzle
11 Bristle Brush for 12" Floor Nozzle
25 46" Steel Extension Handle
— 12" Fibre Floor Tool For 12" Floor Nozzle (Not Illustrated)

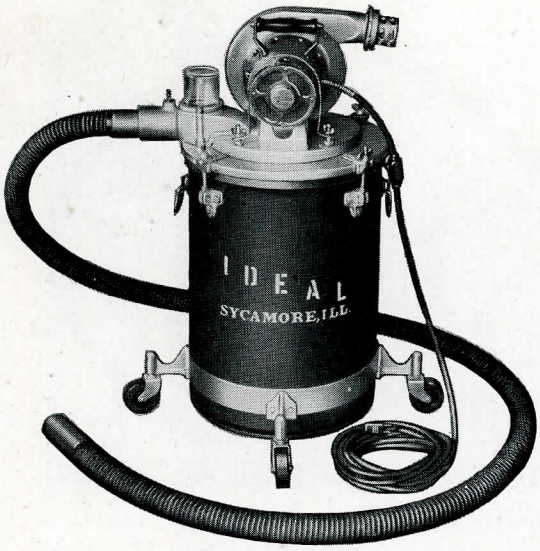


Special Attachments for IDEAL Industrial Cleaners

Cat. No.	*Illust. No.*	*Description*
22-028	4	Flat Fibre Nozzle
22-029	10	Rubber Blowing Nozzle
20-030	—	5" Metal Nozzle
22-031	20	6" Metal Nozzle
22-032	12	12" Metal Floor Nozzle with elbow for use with No. 22-073
22-033	69	18" Metal Floor Nozzle with elbow for use with No. 22-073
22-034	64	Semi-Steel Nozzle
22-035	50	12" Semi-Steel Nozzle
22-036	17	Scraper Nozzle
22-037	52	Flue Cleaning Nozzle 4½" wide
22-038	65	Funnel-Shaped Nozzle, available in 2½", 3", 3½" or 4" dia. (Specify size)
22-039	67	Tapered Nozzle with 1" Opening
22-040	21	Nozzle & Brush for Inside of Furnace Pipes 9" and up
22-041	22	Nozzle & Brush for Inside of Furnace Pipes 5" and 8"
22-042	24	Nozzle & Brush for Outside of Furnace Pipes
22-043	5	Bristle Brush with Clamp for 6" Nozzle
22-045	13	8" Adjustable Wall Brush
22-046	11	Bristle Brush for 12" Floor Nozzle
22-047	70	18" Brush for 18" Floor Nozzle
22-049	32	Wire Flue Brush 4" dia. with 5" Flexible Handle
22-050	18	Wire Brush and Nozzle for Flue Cleaning
22-051	38	Wire Brush ⅞" dia. x 4½" L. for 22-062 and 22-063
22-052	61	Wire Brush for Gas Fired Furnace Flues
22-053	66	Wire Brush for Funnel Shaped Nozzle No. 22-038 (Specify size)
22-054	68	12" Fibre Floor Tool for 12" Floor Nozzle
22-055	59	Felt Floor Tool for 12" Floor Nozzle
22-056	71	Fibre Floor Tool for 18" Floor Nozzle
22-057	74	Felt Floor Tool for 18" Floor Nozzle
22-058	33	Flat Steel Cleaning Tool, 28" Long
22-059	80	Venetian Blind Cleaning Tool
22-060	34	Gas Furnace and Boiler Tool 48" Flat Tubing
22-061	35	Gas Furnace and Boiler Tool 30" Flat Tubing
22-062	36	Gas Furnace and Boiler Tool 48" Square Tubing
22-063	37	Gas Furnace and Boiler Tool 30" Square Tubing
22-064		4'x1¼" Hose for Vacuum and Spraying
22-065	63	10'x1½" Flexible Rubber Covered Hose, no swivel connection
22-066	58	20'x1½" Flexible Rubber Covered Hose, no swivel connection
22-067	30	8'x1½" Fire Dept. Covered Hose, no swivel connection
22-068	3	4'x1½" Rubber Covered Hose
22-069	31	6' Flexible Metal Hose (connects to rubber hose)
22-070	46	20' Flex. Metal Hose (connects to suction intake)
22-071	—	10' Rubber Covered Hose with Swivel Sleeve
22-072	—	20' Rubber Covered Hose with Swivel Sleeve
22-073	25	46" Steel Extension Handle
22-074	25A	46" Steel Extension Handle with sleeve to connect to No. 22-073
22-075	47	8' Steel Handle with Asbestos Pad and Threaded Coupling
22-076	47A	8' Steel Handle less Asbestos Pad and Threaded Coupling
22-077	48	8' Steel Extension Handle with sleeve to connect to Nos. 22-073, 22-075 or 22-076
22-078	49	Sliding Asbestos Handle for No. 22-075
22-080	2	1¼" Hose Connection for Spraying Attachments
22-081	—	1½" Hose Connection
22-082	7	Dust Bag Complete for Hand Cleaners
22-083	28A	Large Dust-Proof Bag for Tank Type Cleaners
22-084	—	Powder & Liquid Sprayer (Quart Size)
22-085	60	Powder & Liquid Sprayer (Pint Size)
22-086	8	Spray Tank
22-087	23	Elbow for 22-040 and 22-041
22-088	62	Nipple for Connecting 2 pieces of 1½" dia. Hose
22-089	1	Shoulder Strap
22-090	—	Scrap Keeper
22-093	—	Adjustable Round Nozzle and Brush
22-094	—	12" Carpet Nozzle with Rubber Bumper
22-095	—	18" Carpet Nozzle with Rubber Bumper
22-096	—	Soft Rubber Blower Nozzle, fits end of hose
22-097	—	Rubberized fabric floor tool for 12" Nozzle
22-098	—	Rubberized fabric floor tool for 18" Nozzle
22-099	—	Double curved handle for floor nozzles 22-100 and 22-101
22-100	—	12" Floor Nozzle for use with double curved handle No. 22-099
22-101	—	18" Floor Nozzle for use with double curved handle No. 22-099
22-102	—	Baffle
22-105	—	Squeegee Nozzle



See Hints and Tables, Pages 71 to 88



INEXPENSIVE!

IDEAL for use in Mines, Foundries, Porcelain Plants, Etc. Also Takes Up Water After Scrubbing Rugs and Floors.

"WATER PICK UP" TANK TYPE CLEANER

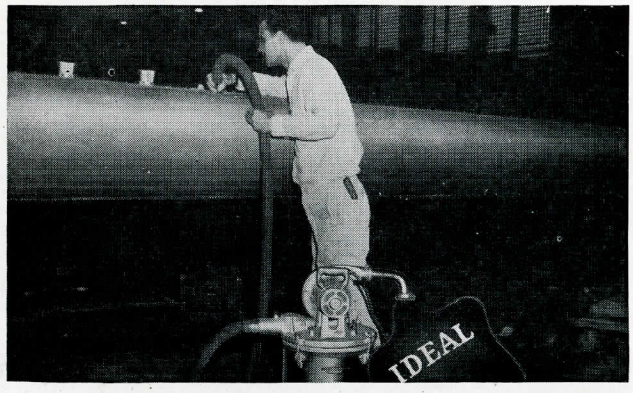
If your problem is cleaning up water after scrubbing or picking up abrasive dust and dirt—the IDEAL "Water Pick Up" Cleaner is what you need. It is designed so that neither dust nor moisture reaches the bearings. There are no mechanical complications and there is nothing that might wear out and admit dirt later on.

Special Construction

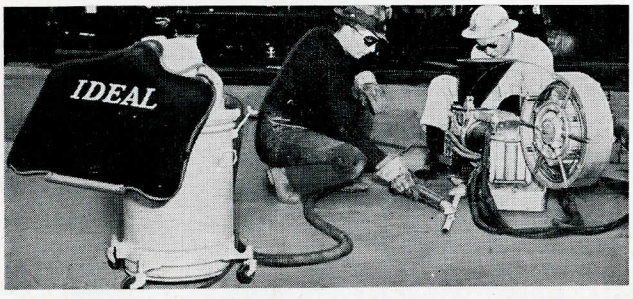
This essential protection is provided by a simple method of releasing the pressure on the bearings. An auxiliary chamber is provided between the fan chamber and motor housing. Small vents around the periphery release the pressure in this chamber. At the same time, the fan hub, projecting slightly into the auxiliary chamber, prevents dust and moisture from creeping along the shaft. This Cleaner is identical to the No. 22-020 "Tank Type" Model, except for special power unit construction described above. Has full 1 HP universal motor, ball bearing construction throughout. Blower air velocity, 24,900 ft. per minute. 12 gal. rust-proof finished steel tank. Rolls easily on four large casters. Shipping weight—78 lbs. (Formerly Catalog No. 120).

NO. 22-025.....*115 v, AC-DC*
NO. 22-026.....*230 v, AC-DC*

STANDARD ATTACHMENTS recommended for use with this Cleaner are 10′ rubber covered hose, 46″ steel extension handle, 12″ floor nozzle, squeegee nozzle and baffle.



Recovering rivets and small lost parts from airplane wing, after assembly.



In shipyard. Recovering flux after welding.

"SCRAP RECOVERY" TANK TYPE CLEANER

Salvages Valuable Scrap, Flux, etc.

Handles hot flux, abrasives, metal dust, etc., with absolute safety. Recovers rivets, screws and other small parts lost on production lines. Quickly pays for itself through recovery of valuable scrap and material.

Special design of suction unit assures long life and trouble-free operation. Bearings protected against abrasive dust, heat and moisture by auxiliary pressure relief chamber. Used extensively by shipyards for recovering welding flux, also in aircraft factories for cleaning wing assemblies, etc., on the production line. Saves time and labor due to extreme portability. Weighs only 78 lbs. Take it anywhere—No permanent installation required. Low operating cost!

Same high efficiency as other IDEAL Tank Type Cleaners. Handles 185 cubic feet of air per minute. 12 gallon capacity tank—easy to empty—mounted on four easy rolling casters. Large dustproof bag included.

NO. 22-025 .....*115 v, AC-DC*
NO. 22-026 .....*230 v, AC-DC*

STANDARD ATTACHMENTS recommended for use with this Cleaner are" 10′ x 1½″ rubber covered hose, flat fibre nozzle, 5″ aluminum nozzle with brush, 12″ floor nozzle with bristle brush, rubber blowing nozzle, 46″ steel extension handle.

Electric BRAZING UNIT

For Brazing And Soldering With Silver Solder

It's easy to braze brass, copper, bronze, steel and dissimilar metals with this *new* Electric Brazer. More satisfactory than any other method, because the work is held firmly in the plier jaws and heat is evenly distributed throughout the metal.

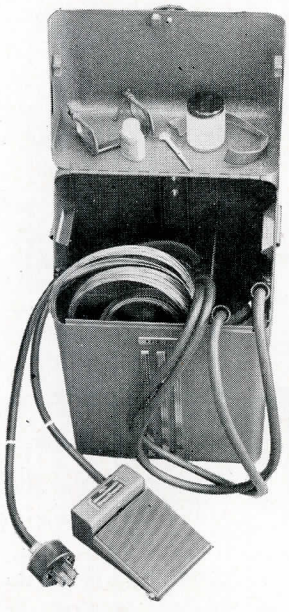
No Special Training Required

With but a few minutes practice, the average workman can braze successfully. There's no pre-heating—no tricky open flame—no heavy tank or bulky hose. The IDEAL Brazer is compact, portable, easy to use and always ready in shop or field. Work is held in the heating pliers and quickly brought to "silver soldering" temperature. Leaves one hand free for applying flux and solder. Completely eliminates makeshift methods and special jigs for holding the work.

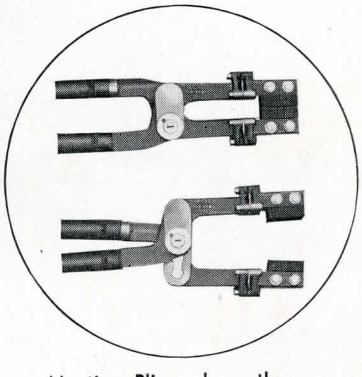
Heating Is Controlled

Heating is controlled by a large rugged foot switch which is normally "Off" and makes contact when pressed from any angle. By switching the current "On" and "Off" intermittently, the heat is evenly distributed throughout the plier jaws and work held between them, thus avoiding hot spots. Heating is continued in this manner until the proper brazing temperature is reached, which is indicated by the free-flowing of the brazing alloy. With a little experience, this temperature is readily recognized. Further heating beyond this point, accomplishes nothing and may be dangerous.

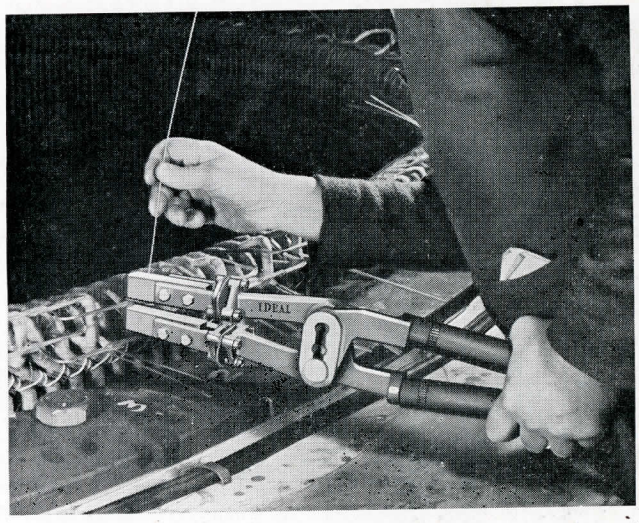
As the current is switched "Off," pressure on the joint should be increased to insure positive contact. The pressure should not be removed nor the joints disturbed until the alloy is set. The carbons and jaws may be cooled by dipping in water if necessary. The flux, if any is used, should be thinned with distilled water as dry flux is an insulator and when too much is applied, will break the circuit between the work.



PORTABLE—All parts enclosed when not in use.



Heating Pliers—have three position opening—carbons are detachable.



Brazing wire connections in electric motor—432 connections in all. User estimates that brazing instead of soldering saves 4 tons of tin a year. BRAZING SAVES CRITICAL MATERIALS.

Makes Lap, Butt, Scarf and Cable Joints

Uses include the making of electrical connections in motors and transformers; soldering lugs, terminals and bus bars; repairing band saws, etc. Easily makes butt, lap, scarf, cable or spud joints.

The advantages of silver solder over soft solders are greater strength and lower electrical resistance—SAVES CRITICAL MATERIALS—TIN AND LEAD.

Important Features

The jaws of the heating pliers have detachable carbon holders. This makes it easy and inexpensive to replace them after long usage. The jaws also open to three different positions so that relatively small as well as large objects can be held and heated.

Large, flat type carbons are regularly supplied in the heating pliers, but for any special work, these may be filed to the shape best suited for the particular job.

Specifications

Rating: 7½ KVA (Single Phase only).

Plier Dimensions: Length of throat—6¼". Carbon Face 1¾"x2".

Foot Switch: Momentary type, normally in OFF position.

Leads: Primary—10', Switch—6', Jaws—6'.

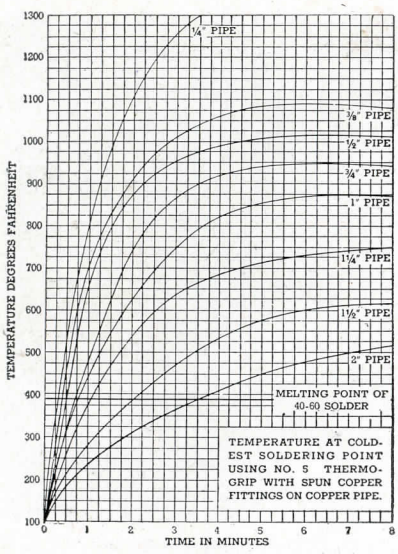
Plug and Receptacle: 3 prong type with long prong for ground.

Dimensions: 14" wide x 12" long x 25" high (with handle 39").

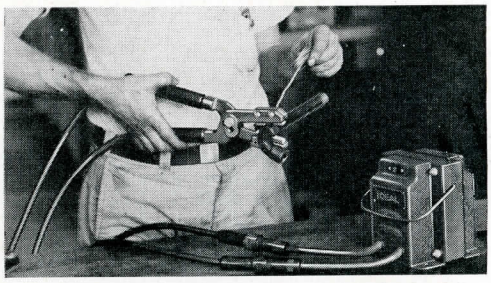
Weight: 100 lbs. (60 cy. unit); 150 lbs. (25 cy. unit).

CATALOG NO. 10-005	230 v, 50-60 cy.
CATALOG NO. 10-007	460 v, 50-60 cy.
CATALOG NO. 10-006	230 v, 25 cy.
CATALOG NO. 10-008	460 v, 25 cy.
CATALOG NO. L-1456	Extra Carbons

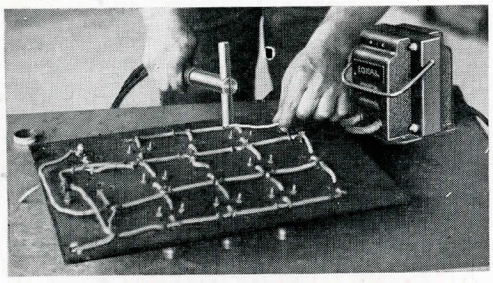
See Hints and Tables, Pages 71 to 88



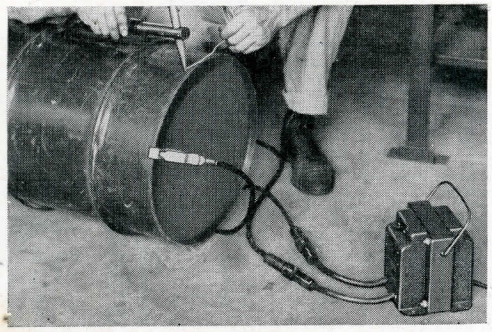
Here's how fast the No. 5 "Thermo-Grip" Plier Attachment heats to high temperatures. No other ordinary soldering method can do this.



No. 5 Plier Attachment Soldering Copper Fitting.



No. 5 Fork Attachment Soldering Terminals.



Seam Soldering with No. 5 Pencil Attachment.

"Thermo-Grip
SOLDERING TOOLS

CONTROLLED HEAT!

Clean — Economical — Portable — Safe

Patented—No. 2,243,086

IDEAL "Thermo-Grips" are not just more ordinary soldering irons, they're handy soldering tools, designed to handle a wide variety of soldering jobs. Whether it is soldering terminals or lugs, spot soldering or seam soldering, "Thermo-Grips" can do a *better* job—*quicker.* The No. 5 "Master Size" Thermo-Grip (illustrated on opposite page) for example, includes a power unit with nine (9) attachments—each designed to do a specific type of soldering job—better!

Faster—Safer

"Thermo-Grip" Soldering Tools operate on a resistance heating principle. Simply plug into suitable outlet, press switch to "On" and the "Thermo-Grip" is ready for soldering. Touching the work with the tool completes the secondary power unit circuit, and causes the part touched to heat almost instantly.

No Preheating Necessary

All current carrying parts are carefully insulated. The current is reduced to a *harmless* low voltage—no chance of electrical shock. Operation is quick and clean—absolutely no open flame.

Better Work—Controlled Heat

"Thermo-Grips" do not oxidize the tin in the solder, do not weaken the solder or discolor the finished job as with an open flame. *The heat is concentrated* on the exact spot where it is needed. There is no danger of melting nearby joints or of burning other parts. Ideal for working in close quarters.

Conserve Power—Easy To Use

IDEAL "Thermo-Grips" draw current only when actually in use and when in contact with the object to be heated—and then use only a very small amount, about the same as a 1,000 watt electric iron.

Thousands of "Thermo-Grips" are in use today, helping to speed production. They're easy to use—require no special training and are always ready for instant heating. Available for use on alternating current only.

Thousands in Use!

NO

Spare Fuel Tanks
Open Flame
Torch
Gas Flame
Matches
Electric Shock or Burns

NO

Burned Insulation
Preheating
Burned or Smoked Walls
Burned or Smoked Ceilings

LET IDEAL ENGINEERS HELP YOU SOLVE YOUR SOLDERING PROBLEM. Simply submit samples of work you wish to solder and *experienced* IDEAL Engineers will be glad to recommend the "Thermo-Grip" best suited to your particular need.

See Hints and Tables, Pages 71 to 88

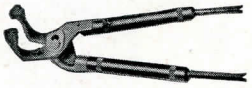
"MASTER SIZE" THERMO-GRIP SET

This Size Intended for Practically Every Ordinary Soldering Job.

The "Master Size" Thermo-Grip including a No. 5 Power Unit is available with one or more Attachments as selected. The complete set (Power Unit and 8 Attachments illustrated below) is furnished unless specific Attachments are ordered.

NO. 5 "PLIER" ATTACHMENT

12-038.....For solder lugs and terminals up to 400 ampere size, threadless copper pipe and fittings up to 1" diameter. Work held between jaws while heating. 5' leads. Rating, 1150 watts. Weight, 4½ lbs. (Extra carbons No. L-271.)

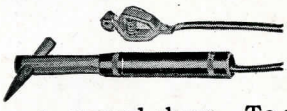


NO. 5 "RIGHT ANGLE PLIER" ATTACHMENT

12-041.....Made with long tong-like jaws that reach into places inaccessible to other styles. Grips work while heating. Sweats pipe up to ⅝". 5' leads. Rating, 850 watts. Weight, 4¼ lbs. (Extra carbons No. L-566.)

NO. 2 "PLIER" ATTACHMENT

12-023.....For small work such as small terminals and lugs up to 150 ampere size, threadless copper tubing or fittings up to ⅜" diameter. Grips work while heating. Has 5' leads. Rating, 300 watts. Weight, 2 lbs. (Extra carbons No. L-505.)



NO. 5 "PENCIL" ATTACHMENT

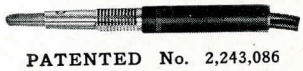
12-040.....Includes carbon point with 5' lead and separate ground clamp. To use, attach clamp to metal part and touch "pencil" at spot to be soldered. Rating, 800 watts. Weight, 4½ lbs. (Extra carbons No. L-337.)

NO. 2 "PENCIL" ATTACHMENT

12-024.....For light seam and spot soldering, ¼" diameter carbon electrode may be fixed either in line with or at 45 degrees to handle. 5' lead and ground clamp. Rating 180 watts. Weight, 1½ lbs. (Extra carbons No. L-583.)

NO. 5 "FORK" ATTACHMENT

12-039.....Two carbons mounted in a single handle. Touching the bi-carbon end to metal completes secondary circuit—instantly heating part to soldering temperature. 5' leads. Rating, 800 watts. Weight, 4 lbs. (Extra carbons No. L-340.)



PATENTED No. 2,243,086

NO. 5 "STRAIGHT FORK" ATTACHMENT

12-042.....For spot and seam soldering. Heats faster, delivers approximately 1,000 watts to point of soldering. Head is of special construction with radiating fins for quick cooling, asbestos bakelite handle. Weight 5½ lbs. (Extra carbons No. L-728.)

NO. 2 "FORK" ATTACHMENT

12-025.....Only 8½" long including carbons. For soldering in "tight" places, etc., where bi-carbon end moves between parts and only heats metal where it is held and likely pressed. 5' leads. Rating 200 watts. Weight, 1½ lbs. (Extra carbons No. L-619.)

ETCHER ATTACHMENT

12-043.....Electrically marks on iron, steel and their alloys. Makes a permanent mark on tools, gauges, dies, etc. Includes workplate, carbon resistor and etcher tool with 5' leads. Rating, 320 watts. Weight, 3¾ lbs. (Extra points No. R-247.)

NO. 5 POWER UNIT

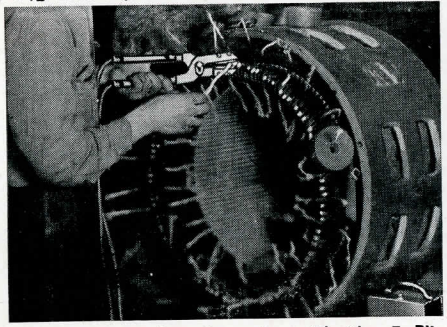
For use with all No. 5 and No. 2 Attachments. Has make-and-break connectors so that any Attachment can be used — then quickly changed for another. Has "Hi-Lo-Off" switch. "Hi" heat, 1150 watts (intermittent), "Lo" heat, 875 watts. 5' primary cord and 1' secondary leads. Weight, 18½ lbs.

NO. 12-034 .....115v, 50-60 cy.
NO. 12-035 .....230v, 50-60 cy.
NO. 12-036 .....115v, 25 cy.
NO. 12-037 .....230v, 25 cy.

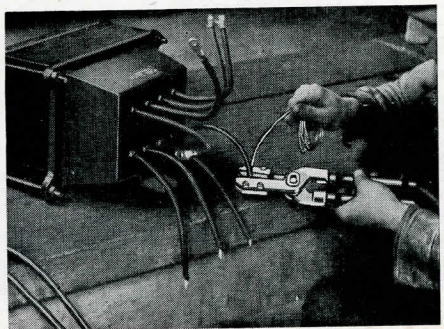
NOTE: For still greater heat when using high melting point solders — use GIANT POWER UNIT, page 34.

WHEN ORDERING Specify Power Unit, Model Numbers and Names of EACH SPECIFIC ATTACHMENT desired.

PATENTED No. 2,243,086



Making connections in motor with No. 5 Plier Attachment

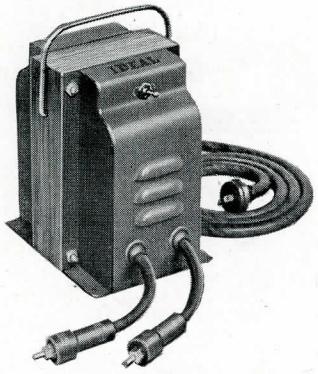


No. 5 Plier Attachment speeds up soldering of lugs.

See Hints and Tables, Pages 71 to 88

"GIANT" SIZE

THERMO-GRIP POWER UNIT



For Use With No. 5 "Master Size" Attachments

- Greater Power
- Faster Soldering
- Two Heat Selection

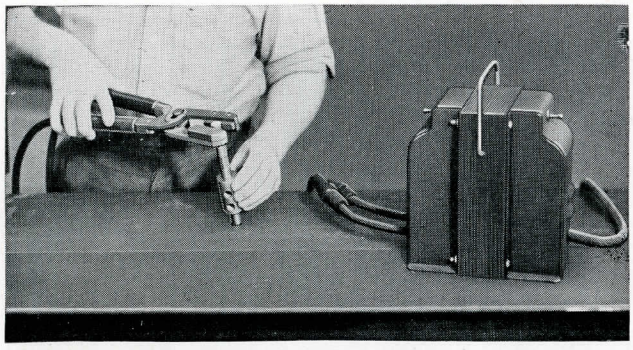
MORE HEAT—FASTER! The "Giant" Power Unit when used with the No. 5 Pliers, No. 5 Pencil, No. 5 Fork, or No. 5 Commutator Riser Attachments, (see page 33 for description of Attachments) delivers 2500 watt power at point of soldering.

For High Melting Point Solders

Especially intended for use with new, higher melting point solders, and for light silver soldering jobs. Due to greatly increased output capacity, the No. 5 "Giant" Power Unit puts extra strain on all attachments. Therefore, attachments should be used only *intermittently*—not intended for heavy duty production soldering.

Power Unit has fully insulated primary and secondary with "Hi-Lo" secondary switch. 10′ primary cord and plug. Has quick make-and-break connector halves on 1 ft. secondary leads. "Hi" heat, 2500 watts, "Lo" heat, 2,125 watts. Weight, 40 lbs.

NO. 12-056.....115v, 50-60 cy. **NO. 12-058**.....115v, 25 cy.
NO. 12-057.....230v, 50-60 cy. **NO. 12-059**.....230v, 25 cy.



Fast, high "Thermo-Grip" heat quickly seals cap on copper alloy electrode used in refrigerating unit.

"MIDGET" SIZE

THERMO-GRIP SET

For All Kinds of Light Soldering

No. 2 Power Unit.

Any one or all four (4) of the Attachments illustrated below may be used with the No. 2 Power Unit.

The No. 2 Power Unit has quick make-and-break connectors for easy interchangability of Attachments. Has "Hi-Lo" heat switch. "Hi" heat is 300 watts intermittent, "Lo" heat, 225 watts. Has 5′ primary cord and 1′ secondary leads. Weight, 9 lbs.

NO. 12-019.....115v, 50-60 cy. **NO. 12-020**.....115v, 25 cy.
NO. 12-021.....230v, 50-60 cy. **NO. 12-022**.....230v, 25 cy.

NO. 2 "PLIER" ATTACHMENT

12-023.....For small work such as small terminals and lugs up to 150 ampere size, threadless copper tubing and fittings up to ⅜" diameter. Grips work while heating. Has 5′ leads. Rating, 300 watts. Weight, 2 lbs. (Extra carbons No. L-505.)

NO. 2 "PENCIL" ATTACHMENT

12-024.....For light seam and spot soldering. ¼" diameter carbon electrode. May be fixed either in line with or at 45° to handle. 5′ lead and ground clamp. Rating, 180 watts. Weight 1½ lbs. (Extra carbons No. L-583.)

NO. 2 "FORK" ATTACHMENT

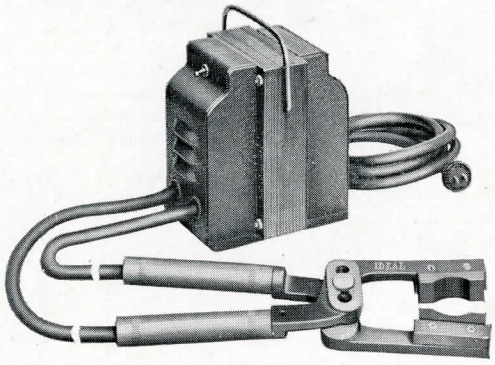
12-025.....Only 8½" long, including carbons. For soldering in "close places," etc., where bi-carbon end moves between parts and only heats metal where it is held and lightly pressed. 5′ leads. Rating 200 watts. Weight, 1½ lbs. (Extra carbons No. L-619.)

ETCHER ATTACHMENT

12-043.....Electrically marks on iron, steel and their alloys. Makes a permanent mark on tools, gauges, dies, etc. Includes work-plate, carbon resistor and etcher tool with 5′ leads. Rating, 320 watts. Weight, 3¾ lbs. (Extra points No. R-247.)

WHEN ORDERING—specify POWER UNIT, Model Numbers and Names of EACH SPECIFIC ATTACHMENT Desired.

"HEAVY DUTY"
THERMO-GRIP PLIERS



For "BIG" Soldering Jobs

This "Thermo-Grip" is a plier type tool intended for large size work. Solders lugs up to 1050 ampere size, makes heavy stator connections, sweats or unsweats copper pipe and fittings up to 2½" in diameter, and if used intermittently, for soldering operations on pipe or fittings up to 4" in diameter.

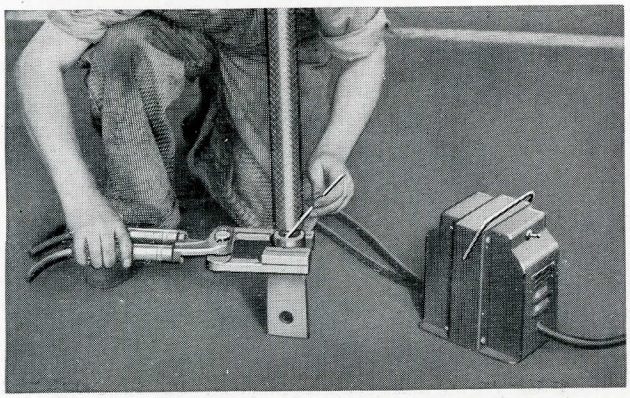
It is extremely adaptable for heavy work around industrial plants, railroads and motor repair shops, as well as for large soldering work in air conditioning, refrigeration, plumbing and heating fields. Particularly well suited for production use.

When IDEAL Thermo-Grip Pliers are used, heating is more rapid and satisfactory than by any other method because the pliers grip the work in two places and evenly heat the metal between them. Does better work—quicker—at less expense.

Built To Take It

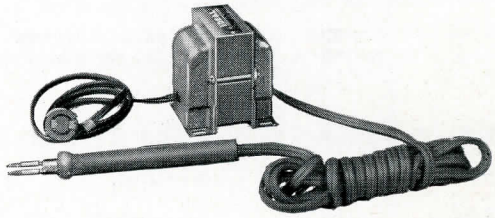
Power Unit has fully insulated primary, continuous secondary leads and "Hi-Lo" secondary heat switch. "Hi" heat is 2500 watts intermittent, "Lo" heat 2125 watts. Pliers are cast bronze with three position opening. Plier handles are of heat insulating fibre tubing. Secondary cables are flexible, heavy duty type, rubber covered, 6' long. Has primary cord and plug. Carbons have high heat capacity and mechanical strength — (extra carbons No. L-323). (Flat carbons L-199-1 also available.) Weight 62 lbs. Formerly catalog No. 10.)

NO.12-048....115 v, 50-60 cy. **NO.12-050**.....115 v, 25 cy.
NO.12-049....230 v, 50-60 cy. **NO.12-051**.....230 v, 25 cy.



Sweating 1050 ampere solder lug onto cable with "Heavy Duty" Thermo-Grip.

"INSTANT HEAT"
ELECTRIC SOLDERER



For Delicate Soldering Jobs

Here is a brand new electric soldering tool that is especially made for all kinds of service work. *No preheating is necessary*—no precious time is wasted. The bi-carbon end heats instantly upon touching the point or terminal to be soldered.

The ideal tool for delicate soldering work: i.e., fine instruments, light radio repairs, small fuses, telephone repairs, inspector or linemen tool kits and home use. A handy tool that every serviceman should have in his kit.

SAFE TO USE

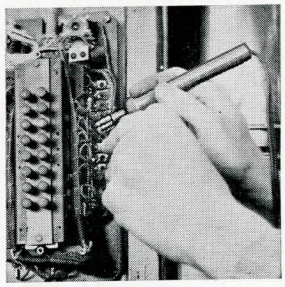
Heating stops instantly as carbons are taken away from wire or terminal. Not a second is wasted. Can be laid down without fear of scorching article it touches—no special holder is required. After job is finished, the "Instant Heat" Solderer can conveniently be put in the kit, ready for the next job.

No danger from electrical shock or burn. Line current is reduced by transformer to harmless low voltage. When soldering, *the heat is concentrated on exact spot being soldered*—no danger of damaging adjacent delicate parts. *Uses current only when in actual contact with work.*

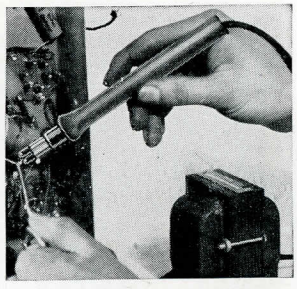
SPECIFICATIONS

Includes power unit with 5 ft. secondary cord and soldering tool. Size of tool only 6¾" x ⅝" diam. Extra carbons *No. L-845. Weight 1½ lbs. (Formerly Catalog No. 1.)*

NO. 12-005...115 v, 50-60 cy. **NO. 12-007**.....115 v, 25 cy.
NO. 12-006...230 v, 50-60 cy. **NO. 12-008**.....230 v, 25 cy.



Speeds intermittent soldering in telephone work.



A mighty hand tool for radio service men.

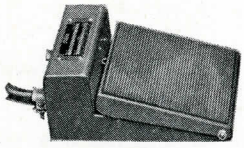
FOOT SWITCH

For Production Work—leaves both hands free! Provides a fast, sure and safe method of switching current on and off. Saves current. Eliminates sparking and arcing at jaws. Available for use with all IDEAL Thermo-Grips.

Rugged construction assures dependable control. Switch is two pole, momentary contact type, normally in "off" position.

Many Uses---Wherever Power is Switched "On-Off"

NO. 38-002

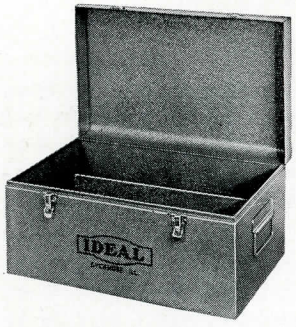


NO.38-004

CATALOG NO. 38-004 .....10 amp. 125 volt (weight 2 lbs.)

CATALOG NO. 38-004 .....{20 amp. 125 volt (weight 5¼ lbs.) / 10 amp. 250 volt

CARRYING CASE



Light weight—all metal. Handy for carrying IDEAL Thermo-Grip Soldering Tools between jobs and for storing when not in use. Size I-100 for all No. 2 units and for No. 5 Power Unit with one or two Attachments. Size I-101 for No. 5 Power Unit with three or more Attachments; also for No. 10 Unit.

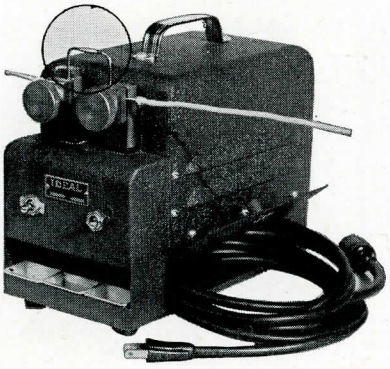
CATALOG NO. I-100 .....14½"x 9½"x7 ". Weight 5 lbs.

CATALOG NO. I-101 .....20½"x12 "x9½". Weight 9 lbs.

ELECTRIC WIRE BRAZER

Repairs Broken Wire. Brazes Ends Together—Quickly!

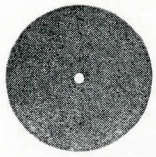
For any size copper wire from No. 8 to 24 gauge. Simply bend wire ends and place them in brazer jaws with ends butted together. Wire instantly heats to brazing temperature as switch is pressed. The joint is made by first applying flux and then a touch of silver solder. "Hi"—500 watt, and "Lo" 300 watt heats provide for differences in wire sizes. Three pans conveniently located in front for acid, flux and water. PORTABLE—overall size only 5"x7"x9¼". Weight 15 lbs. (Formerly catalog No. 58.)



NO. 10-001
115 v. 50-60 cy.

PATENTED
Manufactured under license arrangement with Western Electric Company.

SANDING DISCS



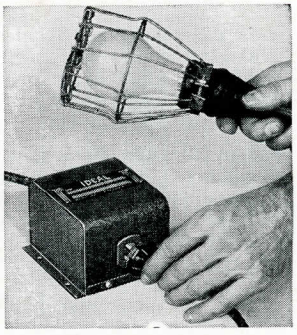
IDEAL Sanding Discs are suitable for armature slot cleaning or general sanding jobs on any material.

Made with a paper back they are easily attached to a Handpiece, using two fibre backing discs (one front and back) and wheel arbor No. 42-006. Has ⅜" hole.

Catalog No.	Diam. (inches)	No. Grain	Fibre Backing Disc Required.
42-023	4	30	L-2468-1
42-024	4	40	L-2468-1
42-025	4	60	L-2468-1
42-026	4	120	L-2468-1
42-027	6	30	K-1007-1
42-028	6	40	K-1007-1
42-029	6	60	K-1007-1
42-030	6	120	K-1007-1
42-031	8	30	K-1008-1
42-032	8	40	K-1008-1
42-033	8	60	K-1008-1
42-034	8	120	K-1008-1

SAFETY EXTENSION UNIT

Protects Workmen Using Extension Lights



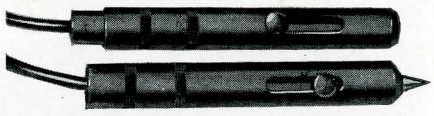
SAFE! Completely eliminates danger of shock caused by a possible short circuit to ground, defective socket, defective cord, etc. Just the thing for inspection or maintenance work in damp, hazardous locations, such as dairies, slaughter houses, boilers, breweries, laundries, excavating projects, steel tanks, ships, or any wet, or otherwise hazardous location where a direct contact with a 115 volt circuit might prove fatal to the worker.

Extension voltage is reduced to a harmless 6 volts. Capacity—50 watts with 25 ft. extension. Longer extensions require proportionately lower watt lamps. Includes 5' three conductor safety type cord and plug. Does not include any extension. Weight 4½ lbs. (Formerly Catalog No. 15.)

NO. 52-001 ..115 v. 50-60 cy. **NO. 52-003** .....115 v. 25 cy.
NO. 52-002 ..230 v. 50-60 cy. **NO. 52-004** .....230 v. 25 cy.

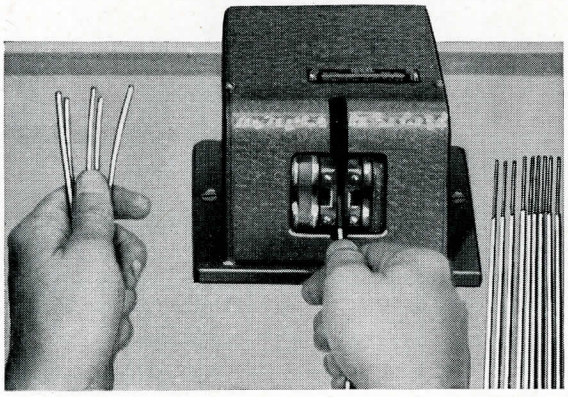
TEST POINTS

Safety Type Points For Use With Test Equipment



NO. 41-006—For use on Hi-Volt Test Equipment. Attaches to cables by soldering. Spring-operated fibre cover protects users from high voltage points. The point can only be bared by pressing forward on the button at side of handle. Maximum rating 2,500 volts, overall length 8", diameter 1". Weight 12 ounces each.

ELECTRIC "HOT BLADE" STRIPPER



Strips Cotton, Silk, Synthetic (Plastic) Insulations or Rubber Coverings from FINE Stranded or Solid Conductors.

PATENTED—Manufactured under License Arrangement with Western Electric Company

For Production Stripping

A new and different Wire Stripper! Insulation is burned off—no cut strands. Easily handles many types of wire used in radio and telephone work, electrical appliances and apparatus—where maximum diameter of insulation does not exceed ¼". Maximum length of stripping is 1".

Strips clean—no frayed ends—no cut wires.

No Nicked Wires

The insulation is burned (not cut) from the wire by two electrically heated blades. When wire is inserted between blades in stripper head and the foot pedal pressed, two parallel grooves are instantly burned through the insulation right down to the conductor—the grooves are completed with a slight twist to right or left—a pull removes the insulation, leaving an even edge. With a little experience, this twist and pull become practically one movement so that the stripper action is very rapid.

Quickly Adjusted

The strands of wire are not nicked or cut because the *blunt* blades cannot harm the finest of wires. Heat from the blades sear and seal the rubber around the conductors.

Each blade has an individual heat control and transformer so that the burning temperature can be separately raised or lowered as desired. This consists of a "Hi-Lo" switch for each blade which permits an instantaneous change from minimum to maximum heat. A rheostat is also installed in the circuit of each blade to provide a very fine adjustment within each of the "Hi" and "Lo" heats. The operator thus has accurate control of the blade heat and can vary it as desired, depending upon the type and thickness of insulation being removed.

The blades are adjustable for diameter of conductors, while an adjustable stop limits length of stripping. After long usage the special steel "hot blades" will become oxidized and coated. They are replaceable at a small cost.

As insulation is stripped from the wire it falls into a Water Drawer provided for mounting under the bench top. Any burning particles are quickly and safely extinguished. Where desirable, a blower may be attached to the drawer to exhaust any fumes or smoke given off by the burning insulation.

Specifications

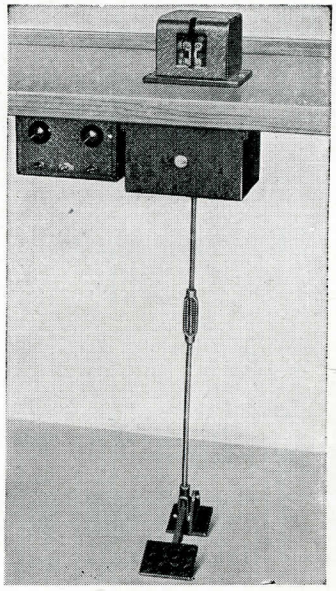
Includes stripper head, control box with transformers, water drawer, foot pedal and connecting rod. Does not include bench as it is intended that stripper be installed on present production line bench. Current draw 1.5 amp. Weight 38 lbs. (Formerly Catalog No. 15).

CATALOG NO. 45-039	115 v. 50-60 cy.
CATALOG NO. 45-040	230 v, 50-60 cy.
CATALOG NO. 45-041	115 v, 25 cy.
CATALOG NO. 45-043	230 v, 25 cy.
CATALOG NO. L-1530	Extra Blades

NOT SUITABLE FOR STRIPPING ASBESTOS, METALLIC OR WEATHERPROOF COVERING

Submit Wire Samples When Ordering

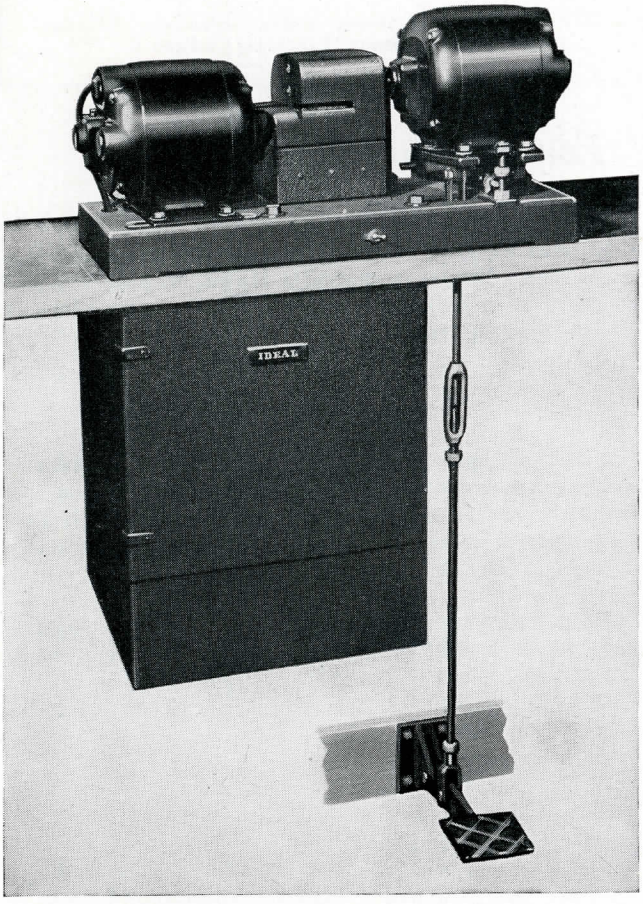
To make sure of getting the Strippers best suited for your particular requirements, submit samples of your wires when ordering. IDEAL Engineers will try them on all Strippers and recommend the best for each individual job.



TWO MOTOR

ELECTRIC "BRUSH TYPE" WIRE STRIPPER

Cleans Coated, Glass Covered and Cotton Covered Wire



Ideal "Brush Type" Wire Stripper installed on production line bench.

IMPORTANT FEATURES:

1. Brushes driven by separate motors.
2. Longer Brush life.
3. Brushes made up of sections—each section replaceable.
4. Suitable for "through" stripping.
5. Dust Collector removes strippings—leaves air clean.

Inexpensive! Completely solves the difficult problem of stripping and cleaning cotton and enamel, silk and enamel, string asbestos and similar types of light insulation from round, flat or rectangular wire—*solid* or *stranded*. Especially suited for cleaning fine "Litz" wire—for removing gummy insulation embedded in stranded wires—for removing the coating from "Formex" and "Formvar" wire—for cleaning fibre glass insulation.

Strips Fast

The wire is simply inserted in the opening and foot pedal pressed. This brings the upper brush down against the wire and the lower brush—between the two rapidly turning brushes, the wire is quickly cleaned. Where desirable, the distance between the brushes may be set to the diameter of wire, thus eliminating the foot pedal action.

An adjustable stop is provided for length of stripping. This is removable for "center" stripping, and for "through " stripping when removing a long section of insulation.

Brush Sizes

Brushes are available with the following diameters of wire:

NO. L-3010-I ..... .0025" Diam. for wire as fine as No. 36 single enamel.
NO. L-3011-I ..... .0040" Diam. for general purpose stripping (furnished as standard).
NO. L-3012-I ..... .0060 Diam. for fabric and enamel wire.
NO. L-3013-I ..... .0090 Diam. for heavy insulation.

Clean---Safe

The Stripper as illustrated includes a "Dust Collector". The Dust Collector which completely removes the dust and dirt of stripping is rated at 60 cu. ft. of air per minute at .55" static pressure. It is driven by a separate motor and has a dust capacity of 1 cu. ft.

A heavy metal hood completely protects the operator from accidentally touching the revolving brushes.

Specifications

WIRE STRIPPER—Furnished with TWO (2) ¼ H.P. Motors 1½" diameter x 2" face x .004" Wire Brushes; and foot pedal and adjustable rods for mounting on any bench (bench not included with Stripper). Overall size 8" x 21" x 10½". Weight 90 lbs.

DUST COLLECTOR—Overall size 14"x13½"x18¾" Weight 20 lbs. Combined shipping weight 140 lbs.

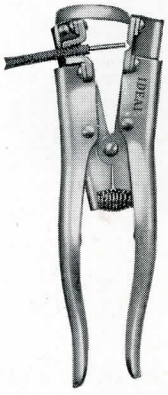
CATALOG NO. 45-070 ..... 115 v, 60 cy.
CATALOG NO. 45-072 ..... 230 v, 60 cy.

BRUSHES MADE IN SECTIONS

The Brushes are made in sections, of special steel wire ground to size. Each section is replaceable as it becomes worn, thus effecting longer brush life and maximum brush economy.

A complete brush is 1½" diameter x 2" face x ⅜" arbor hole. This is made up of 10 sections.

"E-Z" HAND TYPE STRIPPER AND CUTTER



"Automatic" Model

For Stranded or Solid Wire

The IDEAL "E-Z" Stripper and Cutter is a lasting tool—strips fast and clean! Always ready for instant use—requires no 'cocking." Inexpensive! ive!

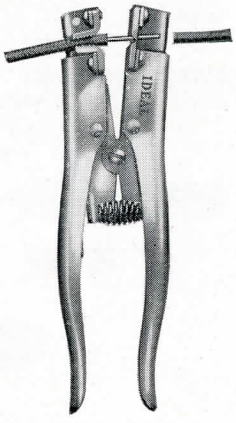
TRIPLE ACTION — Clamps the wire, cuts the insulation and strips it all in one simple operation. A lever stops the return of the arms until the wire is removed after stripping, then they quickly snap back to normal. The lever will not operate unless wire with insulation .050" or larger is inserted between the grippers. If no wire is inserted, the lower gripper simply moves upward when handles are squeezed, pushing trigger and lever up and out of action.

Eliminates wire waste. The cutter edges are shielded (guarding operator's hand) and the blind centers of the V-notches on the blades prevent cutting or scoring of the wire. Blades are replaceable.

Particularly designed for stripping stranded lamp and fixture wire, automotive wire and all other electrical wire—WILL NOT CRUSH STRANDED WIRE! Also suitable for stripping solid conductor wire.

"Standard" Model

For Solid of Stranded Wire



The "Standard" Model is especially designed for stripping solid wire, but also suitable for stranded wire. Stripper is same as "Automatic" Model, except that it does not have a lever to stop return of arms after stripping. When hand pressure is released, the handles open, ready for the next wire.

"E-Z" Strippers are pocket-size, only 7½ inches long and 24 ounces in weight. A handy tool for electricians. Sturdy construction assures long satisfactory and accurate work.

Five Sizes

"Automatic" Model	"Standard" Model	Wire Sizes
No. A-0	No. 0	For Nos. 30, 28, 26, 24, 22 and 20 gauge solid or stranded.
No. A-01	No. 01	For Nos. 22, 20, 18 and 16 wire—solid or stranded.
No. A-1	No. 1	For Nos. 18, 15, 14 and 12 wire—solid or stranded.
No. A-2	No. 2	For Nos. 16, 15, 14, 12 and 10 wire—solid or stranded.
No. A-3	No. 3	For Nos. 14, 12, 10 and 8 wires with heavy insulation—solid or stranded.

NOTE: IDEAL "E-Z" Wire Strippers can be supplied for stripping wire as large as No. 5, provided the outside insulation does not exceed ⅜" in diameter.

"E-Z" FOOT-OPERATED WIRE STRIPPER

A Production Stripper — Particularly Designed for Rubber Covered Wires

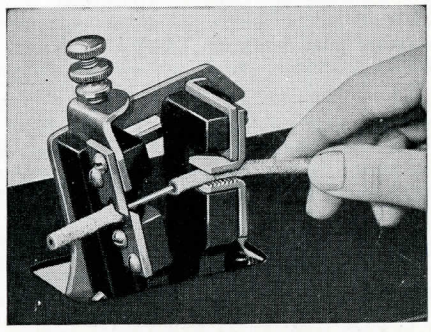
Strips insulation from 8 gauge—⅜" O.D. to the very finest wire—single or stranded. Strips all kinds of plain, twisted, parallel cords and P.O.S.J. cord in one operation. Strips outside sheath and both conductors at one time.

Will accurately and efficiently center strip for junction work on wire where insulation is easily removed.

This stripper comes complete with sturdy metal stand, ready to set up and use immediately. It is foot-operated. Every time the pedal is pressed, the wire is gripped, insulation cut, stripped off and released ready for another wire to be inserted. So simple that any operator can do production stripping with but a few minutes practice. Open side feed permits full vision of work at all times.

Two types of blades are furnished—a single V-notch for single conductors and double VV-notch for duplex cord. A micrometer screw adjustment with a lock nut increases or decreases the size of the stripping hole in the blades, depending upon the diameter of wire to be stripped. Easily adjustable—assures accurate stripping without cut strands, nicked wire or waste.

CATALOG NO. 45-019—(Formerly No. 7). All metal construction, size overall, 18" x 24" x 44", weight, 40 lbs.



Wire is gripped, insulation cut and stripped off with a single step on the foot pedal.

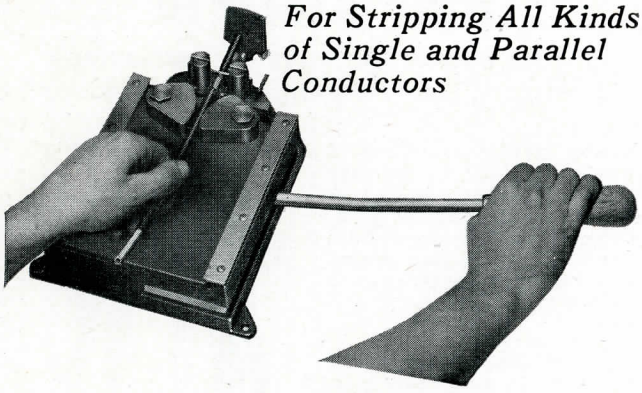
Submit wire samples when ordering. Let experienced IDEAL Engineers recommend the Stripper best suited to your particular needs.

NEW

"Lever Type"

CABLE AND WIRE STRIPPER

For Stripping All Kinds of Single and Parallel Conductors



Strips Cable up to 5/8" Diameter—Any Length!

For volume production! Strips rubber insulation, asbestos, synthetic (plastic), glass, cambric, etc., with one simple operation. Furnished with set of plain blades for stripping parallel wire, heater cord, inner conductors—and P.O.S.J. cord.

Grooved blades are also available for stripping rubber-covered and weatherproof cable.

Important Features

(1) "Straight Line Pull" prevents scraping and nicking of wire; (2) Jaws automatically center and grip any diameter wire—no manual adjustment necessary; (3) Jaws instantly release wire at end of stripping stroke; (4) Blades open automatically to receive wire when lever is pushed forward; (5) Blades are quickly interchangeable; (6) Adjustable stop provides for length of stripping—can be removed when extra long stripping is desired.

Easy To Operate---Straight Line Pull

To use, simply lay wire in position between the jaws and cutting blades and pull the handle. This causes the gripping jaws to grasp the wire and draw the wire through the oscillating blades—stripping it neat and clean. The pulling action is in a "straight line" eliminating scraping and nicking of wire. The operation requires but a moment—well suited for *large volume stripping.*

Grooved blades are available in 15 standard sizes as shown below, furnished at slight extra charge. When ordering, if there is a doubt regarding grooved blades, please submit samples so that proper blades can be furnished.

CATALOG No. 45-064 Furnished with one set of plain blades (No. L-3064). Stripper, less handle, 10" x 8½" x 4"; weight 18½ lbs.

Grooved Blades Available

Blade No.	16L	14L	12L	10L	8L	7L	6L	5L
Hole Diam...	.0595	.0785	.0995	.1200	.1405	.1610	.1820	.2040
For AWG Wire No.	16	14	12	10	8	7	6	5

Blade No.	4L	3L	2L	1L	0L	00L	000L	
Hole Diam...	.2280	.2500	.2812	.3125	.3437	.3906	.4375	
For AWG Wire No.	4	3	2	1	0	00	000	

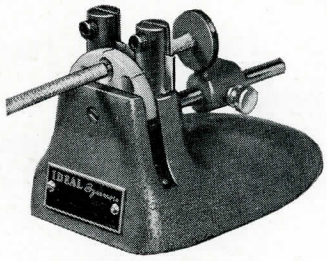
*Based on solid A.W.G.

NEW

"Bench Type"

WIRE STRIPPER

For stripping solid or stranded wire up to 5/16" diameter



HAS 8 HOLE "DIAL" WIRE GUIDE TO CENTER DIFFERENT SIZE WIRE BETWEEN CUTTING BLADES

An inexpensive stripper for fast stripping on small jobs. Mounts on a bench leaving both hands free for stripping. To use—just insert wire between the oscillating blades to the adjustable stop, then—a quick jerk cleanly and neatly removes the insulation.

Strips P. O. S. J. Cord

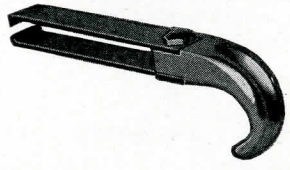
This model is furnished with a set of plain blades for stripping parallel wires, heater cords, inner conductors, P.O.S.J. cord, etc.

Special grooved blades (7 sizes available) for stripping rubber, asbestos and other similarly covered wire furnished at slight extra charge. Practically any type of solid or stranded wire, up to 5/16" diameter can be stripped.

An 8 hole "dial" type wire guide accurately centers the wire between the blades, eliminating guesswork and preventing nicked wires and cut strands.

CATALOG NO. 45-069 Furnished with one set plain blades. Size 5"x3"x3"; weight 2 lbs.

HANDI-GRIP WIRE SKINNER AND WIRE STRAIGHTENER



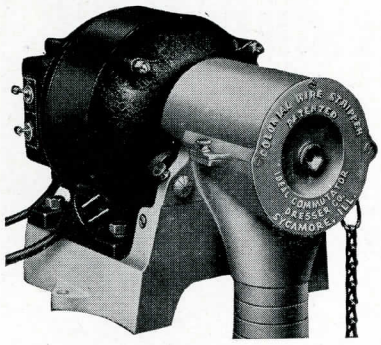
A handy tool designed to cut and strip the insulation, scrape wire and straighten kinks and sharp bends. The hardened tool steel blades have the cutting edges hollowed in the center to prevent the wire from slipping out of the tool. They are removable for resharpening.

The handle hooks around the fingers to give a good pulling grip. Pulling is done entirely with the handle, permitting sensitive pressure on the blades to give correct stripping. The unit is light, compact and sturdy, does not tire the hands.

CATALOG NO. 45-021 (Formerly No. 5). Size of tool only 5¼" long; width of blade, ½"; weight, 3 oz.

"ROTARY TYPE" STRIPPER

Strips Solid or Stranded Wires—
Up to ½" Diameter



Strips Clockwise or Counter-Clockwise!

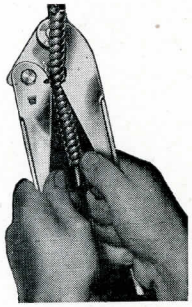
For production stripping—strips all types of solid or stranded wire up to a maximum of ½" outside diameter. Motor is reversible at the flip of switch, permitting either clockwise or counter-clockwise stripping according to natural twist of wire. Wire after stripping is properly twisted and polished, ready for terminals or soldering.

To strip a particular wire, first set dialed micrometer screw (adjustable to 1/1000") at left side to diameter of wire. Insert wire and step on foot pedal. This engages the clutch and causes the blades to turn with the motor. Centrifugal force—not springs—quickly forces the blades through the insulation—a quick pull removes it. The blades are double edged, wear twice as long, made of finest tool steel, carefully hardened and drawn. May be resharpened repeatedly. Overall size approximately 7"x12"x8". Weight 45 lbs. *(Formerly Catalog No. 8).*

CATALOG NO. 45-009 ..... 115 v, 60 cy.
CATALOG NO. 45-010 ..... 230 v, 60 cy.
CATALOG NO. 45-011 ..... 115 v, D.C.
CATALOG NO. 45-012 ..... 230 v, D.C.
CATALOG NO. L-2440 ..... Extra Blade

B-X ARMOR CUTTER

Patented No. 2,246,350



Just Snip—THAT'S ALL!

Just SNIP—and the job's done! That's how easy it is to cut B-X cable with this NEW handy pocket size tool. Cuts either two or three wire, No. 12 or No. 14 cable.

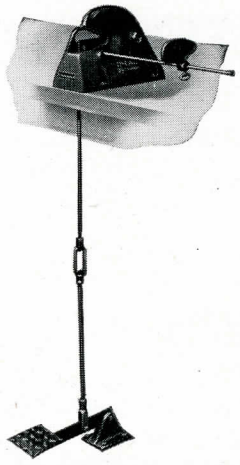
Eliminates spoilage! Eliminates old-fashioned, dangerous hacksaw method of cutting B-X. Cuts cleanly—quickly without injury to wire insulation. Cuts anywhere along length of cable for opening into junction boxes, etc. Special steel cutting blade removable for sharpening. Once you have tried this Cutter, you will never again want to handle B-X without it.

CATALOG NO. 45-023 (Formerly No. 14). Overall length 10". Weight 12 ounces.

Simplex

NEW CABLE AND WIRE CUTTER

Foot Operated



Here is a cutter that has no equal for shearing insulated wire and cable — quickly — cleanly — economically. Easily cuts a handful of small wires, or ⅝" cable with a single step on the foot pedal.

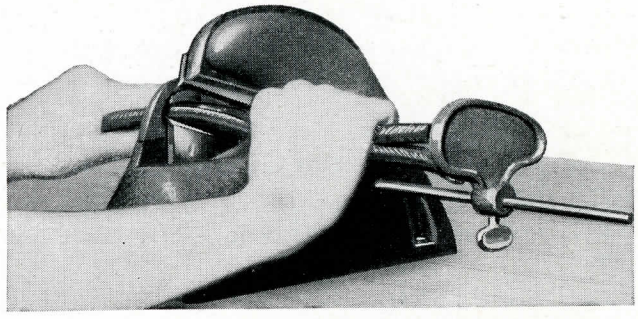
Speeds Work

Speeds up production by cutting a large supply of wire to length in a *few seconds.* Cuts cleanly and efficiently to improve quality of work. Eliminates spoilage.

A wire guide-stop is provided to set the length of cutting. Also has a safety guard. The connecting lever between cutter and foot pedal is adjustable—easily fitted to any work bench or table. This machine is so accurately made and the blade so sharp that it will cut thin paper.

Blades are made of high grade tool steel, hardened and ground. Maximum blade opening is 1", with 3" long cutting edge.

CATALOG NO. 45-048 Size cutting head only, 3" wide x 12" long x 4½" high; weight 20 lbs.



CABLE RIPPER

For use on non-metallic sheathed duplex cable or lead covered cable. Cuts cleanly —quickly—easily—in one simple operation.

Simply squeeze onto cable and pull! Case hardened cutting point gives long service. Can also be used for ripping the outer sheathing of other cords, lead cables, etc., where outside diameter is not greater than ⅝".

CATALOG NO. 45-018 *(Formerly No. 4)*
Overall length 3¾". Weight 2 ounces.

SUBMIT WIRE SAMPLES WHEN ORDERING. LET EXPERIENCED IDEAL ENGINEERS RECOMMEND THE STRIPPER BEST SUITED TO YOUR PARTICULAR NEEDS.

See Hints and Tables, Pages 71 to 88

Rechargeable **IDEAL** *Rechargeable*

STORAGE BATTERY FOR FLASHLIGHTS

(Patent Pending)

- Supplies Powerful, Always Bright Light
- May Be Used Continuously For Hours
- Saves Expense of Replacing Dry Cells
- Quickly Pays For Itself
- Precision Built—Rugged Construction
- Weatherproof and Moisture Proof
- Minimum of Care Required
- Easily Charged—Anywhere

Fits Standard Flashlight Cases — Takes The Place of TWO 1¼" Size D Dry Cells

Full Size
Catalog No. 21-001

It's a pleasure to use the IDEAL Flashlight Battery, for it gives an unlimited amount of bright light. Built like the regular automobile battery, it can, with proper care last for years. Gives *real* flashlight enjoyment. Instead of letting your light get dim as with dry cells, simply keep the IDEAL Battery charged and its *always like new*.

Outlasts Hundreds of Dry Cells

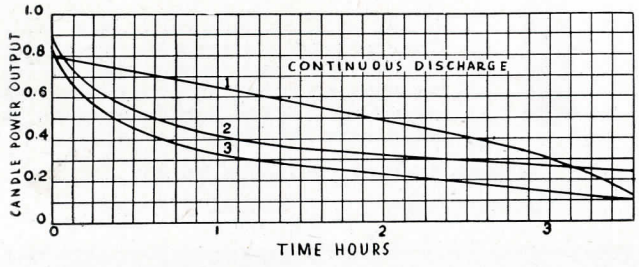
It can actually *replace up to FOUR HUNDRED or more dry cells.* Instead of constantly using new cells and then throwing them away, the IDEAL Battery can be easily recharged. No matter how much the flashlight is used—if used like a hand lantern, recharging keeps the battery always fresh and the light bright.

With proper care and recharging, one IDEAL Battery can give up to 1,000 hours or more of dependable light service.

Discharge Curve

The Discharge Curve (below) shows why IDEAL (Rechargeable) Flashlight Batteries give bright, uniform light.

Instead of using a battery until the light is dim (which is necessary with dry cells to obtain full service) the IDEAL Battery can be recharged after only a slight drop in light output. This assures dependable, bright light at all times. For best light service it is recommended that the IDEAL Battery be used for only part of its discharged life and then recharged.



1. One IDEAL Flashlight Battery.
2. Two Industrial Flashlight cells.
3. Two Ordinary Flashlight Cells.

Specifications

DIMENSIONS—1 11/32" diameter by 4¾" high.

WEIGHT—approximately 7 ounces.

CASE—transparent plastic.

PLATES—pasted lead oxide.

POLARITY—positive pole on bottom.

VOLTS—2.2 volts open circuit.

DISCHARGE RATE—600 mills.

CAPACITY—2 ampere hours.

SPILLPROOF—Spillage and creeping corrosion are eliminated.

NOT AFFECTED BY WATER OR SALT AIR—Especially suitable for use aboard ship.

CATALOG NO. 21-001 *(Formerly No. 44).*

SPACER PLUG

NO. 21-037 For use with one (1) IDEAL Battery in 3-cell flashlight case, or with two (2) IDEAL Batteries in 5-cell flashlight case.

THOUSANDS IN USE!

Reduces Flashlight Battery Cost Up To 75%

HERE'S HOW—In heavy service, a single discharge of one IDEAL Flashlight Battery is equal to the practical use of one pair of ordinary size D Dry Cells (charging cost is negligible).

With an anticipated service life of up to 200 or more discharges from one IDEAL Flashlight Battery, it can equal in use 400 size D Dry Cells. Dividing the cost of one IDEAL Storage Battery by 200 gives the very low comparative cost of each discharge as compared to the cost of two dry cells.

Saves Up To $10.00 Per Flashlight

Thus, a single IDEAL Storage Battery can save up to $10.00 or more annually (dependent upon use) on each flashlight in service. When multiplied by the number of flashlights used in any particular plant or service, one is astonished at the total savings per year.

Means Big Savings To—

Guards
Watchmen
Inspectors
Maintenance Men
Electricians
Repair Men
Machinists on Precision Jobs
Workers in Stock Rooms
Tool Rooms
Shipping Depts., etc.

Also ideal for use in instruments requiring small D.C. supply.

Guaranteed

The IDEAL Storage Battery is *unconditionally guaranteed* against defects in material and workmanship for a period of six (6) months. Any defective Battery will be replaced at no charge.

Requires Little Care

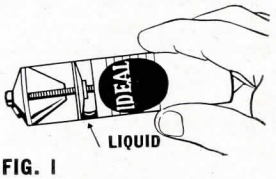


FIG. 1

Charging at convenient periods and addition of distilled water is all that is necessary to keep the IDEAL Battery just like new.

With Battery in constant service, the benefit of top voltage and uniform light will be obtained by charging often. Charging time depends on how heavily the Battery has been used and how long it has gone without charge.

Correct saturation or proper amount of liquid is indicated by a few drops of free running liquid in bottom chamber (figure 1) when Battery is inverted and shaken briskly. When check does not show this free liquid, then distilled water should be added, using medicine dropper (furnished with Battery) as shown in figure 2.

LAMPS

For brightest light, lower voltage lamps designed for the IDEAL Battery are recommended. The screw base lamp available for the focusing flashlight case is Mazda No. 196, and the flange base lamp available for the prefocus case is Mazda No. PR8. Both lamps are rated at 1.9 volt, .6 ampere. DRY CELL LAMPS ARE NOT RECOMMENDED, although they can be used, they do not burn brightly with the IDEAL Battery.

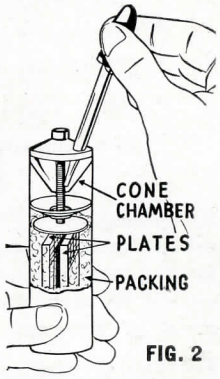


FIG. 2

NO. 53-001
Mazda (196) Screw Base

NO. 53-002
Mazda (PR8) Flanged Base

CHARGE IT ANYWHERE — From Electrical Outlet or Auto Battery

SINGLE CHARGER—NO. 21-038 for 115 volt, 50-60 cycle. Also available for 230 volt and 25 cycle operation. Consists of a small transformer with rectifier plates. Charging current (2 volt amp.) is less than that required to run an electric clock.

AUTOMOBILE CHARGER—NO. 21-043 Easily installed on automobile, truck or bus. Battery may be charged even while auto is not running. Neat and compact. Does not interfere in any way with operation of car.

BATTERY TESTER

CATALOG NO. 21-042

Recommended where a quantity of Batteries are in regular use.

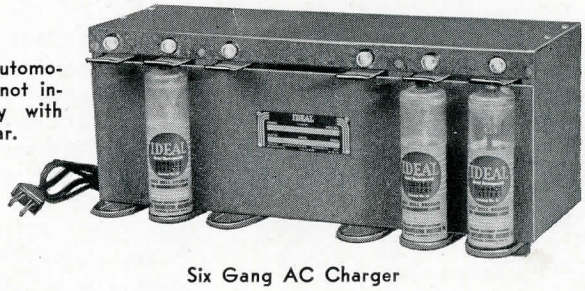
(Upper Right) Automobile Charger. Does not interfere in any way with operation of car.

Single Charger available for AC only.

GANG CHARGERS

NO. 21-011—Six cell gang 115 volt, 50-60 cycle
NO. 21-027—Six cell gang, 125 volt, DC
NO. 21-019—Twelve cell gang, 115 volt, 50-60 cycle
NO. 21-031—Twelve cell gang, 125 volt, DC.

Also available for 230 volts and 25 cycle operation.



Six Gang AC Charger

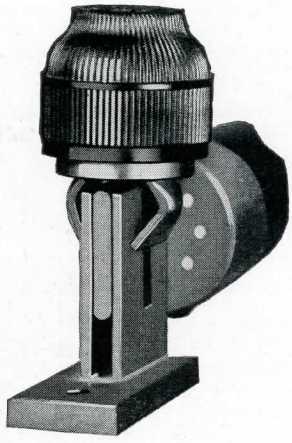
Any number of Batteries from one to capacity can be "put on" or "taken off" charge as desired.

FUSE CLIP CLAMPS

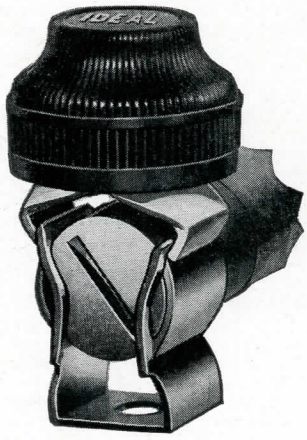
For Knife Or Ferrule Type Fuse Clips or Switch Clips

ADVANTAGES:

- Insure 100% contact permanently.
- Prevent heating and burning of fuses.
- Save Fuses—Save Clips.
- Eliminate costly shut-downs.
- Prevent arcing at contacts.
- Make a weak point strong.
- Eliminate heating of wires and cables.
- Save up to 6% on current consumption.
- Inexpensive.



KNIFE TYPE



FERRULE TYPE

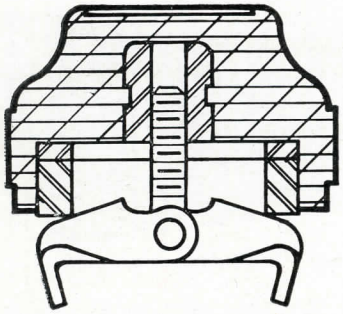
New—Improved IDEAL Fuse Clip Clamps incorporate revolutionary principles of design that insure positive locking action. Once fastened on a knife or ferrule type switch or fuse, they hold securely—in spite of severe shock or vibration. Very efficient.

Extreme pressure against the clip is caused by a heavy cast iron clamping ring that is forced over the outside of the strong reinforced jaws as the knurled bakelite knob is turned. All parts are cadmium plated.

Easy To Fasten On

IDEAL Fuse Clip Clamps are easy to fasten on, for the jaws are held normally open by a spring. A large insulating skirt protects the hands from live contact. The knob has a knurled surface formed to fit the fingers and permit the greatest possible grip. IDEAL Fuse Clip Clamps are extremely adaptable—*grip all makes of clips* from the widest to the narrowest sizes.

IDEAL Fuse Clip Clamps are also easy to take off and use again—simply unscrew the knob. There are no wearing parts—no maintenance—no replacement. They last a lifetime!



Cross section showing simple construction — no parts to wear and replace

When you examine one of these Clamps, you can readily see why they cut down resistance between clips and fuses or switch blades, and soon save their cost many times in the elimination of power loss. See that IDEAL Fuse Clip Clamps are included in your next order—and note the savings.

Reasons Why Ideal Fuse Clip Clamps Save

Completely eliminate arcing and burning at contact (no heating) . . . minimize resistance between fuses and clips or blades . . . reduce power loss and unnecessary shut-downs . . . save up to 6% on current consumption . . . save fuses . . . save clips . . . prevent fuses from heating and burning.

Particularly useful on heavily loaded switches or fuse clips where replacement is frequent. *Inexpensive!*

Seven Sizes

Size	Number	Amps.	Volts
1	32-001 (FERRULE TYPE)	30	250
2	32-002 (FERRULE TYPE)	30 60	600 250
4	32-003 (FERRULE TYPE)	60	600
5	32-004 (KNIFE TYPE)	100 100	250 600
6	32-005 (KNIFE TYPE)	200 200	250 600
*7	32-006 (KNIFE TYPE)	400 400	250 600
8	32-007 (KNIFE TYPE)	600 600	250 600

*Wide jaws of Size 7 Fuse Clip Clamp permits clamping split clips.

Weights, Size (1)—1¼ oz.; (2)—1½ oz.; (4)—2½ oz.; (5)—2¾ oz.; (6)—4 oz.; (7)—7½ oz.; (8)—8 oz.

"Buying cheap, inferior material to save money is like stopping the clock to save time"—specify IDEAL for quality at the lowest price.

See Hints and Tables, Pages 71 to 88

FUSE REDUCERS

Stop Dangerous Over-fusing! Save Delay And Expense Of Buying Special Fuses And Fuse Clips Made to Order

Fuse Reducers protect over-fused circuits without the expense of a change in switch, panel or switchboard equipment, thereby saving considerable time and money. Good engineering practice is maintained.

Often Used On New Installations

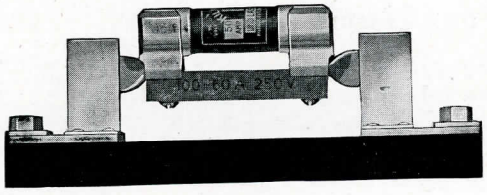
IDEAL Fuse Reducers are very frequently used where new circuits are built on which a considerable increase in load is expected in the near future. With the new circuit intentionally designed for larger switches and fuse gaps, Fuse Reducers may be used at the beginning when the load is light. When the load has been increased, the Fuse Reducer is simply removed and the larger fuse used.

Another popular use of IDEAL Fuse Reducers is on two-phase, three wire circuits, where it is desirable to fuse the outside legs of switches below the switch rating. IDEAL Fuse Reducers are successfully used to obtain this proper fusing since the fuse gaps on the outside legs of the switch are not of the proper size for this lower fusing.

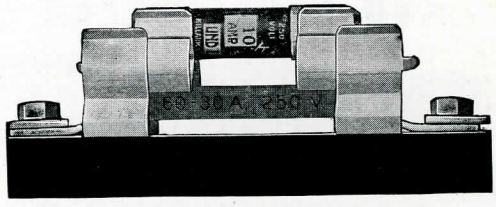
Fully Approved

IDEAL Fuse Reducers are listed by Underwriter's Laboratories, Inc. Standard sizes are made for N.E.C. cartridge fuses, other types made to order.

EASILY INSTALLED—simply snap into clip like ordinary fuse.



KNIFE TYPE



FERRULE TYPE

The tables below list the standard 250 v, and 600 v. Fuse Reducers. Special Reducers are also available for reducing from 600 v. to 250 v. Thus, if a circuit is being changed from 600 v. to 250 v., by means of these special adaptors the same switches, panel boards, cutouts, etc., can be used.

All the more popular size Reducers are carried in stock. However, shipment of the other sizes can be made promptly. Weight range from 2 oz. net up to 16 ozs. net on the larger sizes.

250 Volt Size

Catalog No.	Ampere
*FR-263	60- 30
*FR-213	100- 30
*FR-216	100- 60
*FR-223	200- 30
*FR-226	200- 60
*FR-221	200-100
FR-243	400- 30
*FR-246	400- 60
*FR-241	400-100
*FR-242	400-200
FR-2603	600- 30
FR-266	600- 60
FR-261	600-100
*FR-262	600-200
*FR-264	600-400

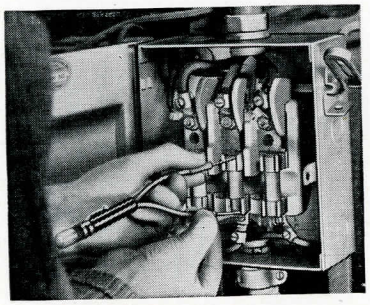
600 Volt Size

Catalog No.	Ampere
*FR-663	60- 30
*FR-613	100- 30
*FR-616	100- 60
*FR-623	200- 30
*FR-626	200- 60
*FR-621	200-100
FR-643	400- 30
FR-646	400- 60
*FR-641	400-100
FR-642	400-200
FR-6603	600- 30
FR-666	600- 60
FR-661	600-100
FR-662	600-200
*FR-664	600-400

*Standard Stock Sizes.

"TEST-GLO"

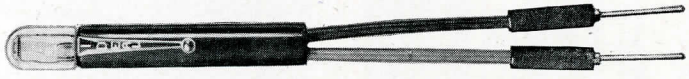
A Handy Pocket Size Test-Lite To Replace Awkward Lamp And Socket Testers



Testing for burned out fuse.

SAFE—For testing electrical and radio circuits, motors, fuses, spark plugs, etc. Indicates (glows) on voltages from 80 volts to 550 volts, AC and DC. (Also 5 to 50 volt size). Brightness of glow is a relative indication of voltage.

Neon test lamp is used in 80-550 volt size and adapted to high voltages by



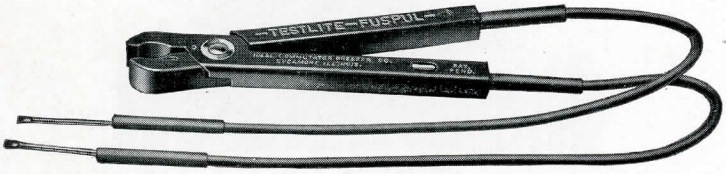
special resistor. Incandescent lamp is used in 5 to 50 volt size. Lamp fully enclosed and protected in transparent rugged plastic housing. Self-contained in neat, streamlined jet black tube. Test lead tips fully insulated. A modern safety tool that every electrician, radio repair man, mechanic and maintenance man should have. Convenient chrome plated pencil clip makes the Test-Glo perfectly suited to vest pocket use. Instantly available when needed. Length of leads 4¾", overall length only 7¼", weight ¾ oz.

CATALOG NO. 35-004—For testing 5 to 50 volts.

CATALOG NO. 35-001—For testing 80 to 550 volts.

See Hints and Tables, Pages 71 to 88

TEST-LITE AND FUSE PULLER



The perfect tool for testing, removing or inserting fuses up to 100 amp., 250 volt; and up to 60 amp., 600 volts. Testing circuits from 110 to 550 volts. (AC or DC) handling all kinds of "live" electrical parts, adjusting loose cut-out clips, etc.

Combines two tools into one—*pocket size!* Eliminates the necessity of carrying both testing equipment and a fuse puller. Being compact in size and light in weight, it takes up little room in either pocket or tool kit.

PROMOTES SAFETY—because of its real convenience, electricians really use the IDEAL Test-Lite and Fuse Puller, instead of merely carrying it. It abolishes the danger of pulling fuses by hand, or testing with makeshift equipment.

Two Tools In One—Pocket Size

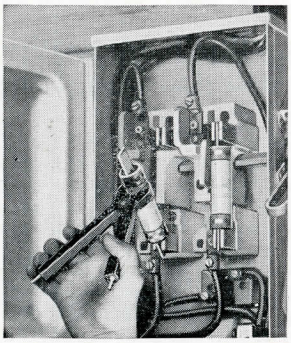
The IDEAL Test-Lite and Fuse Puller is made of highest quality reinforced bakelite and is similar in design to a pair of pliers. Test Pins are mounted in handle ends and are adjusted to various spans by merely opening or closing the handles. The Test-Lite is enclosed in the handle to safeguard against breakage. Length, 7" overall. Weight, 6 ounces.

Available With Flexible Leads

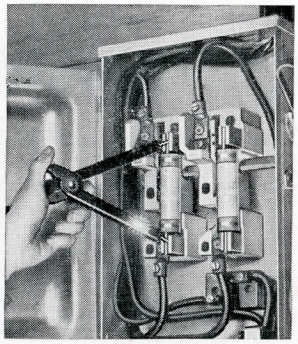
Quickly detachable flexible extension leads, each 18" long —can be purchased at slight additional cost. Lead points are 1⅝" long, of small diameter, therefore can readily be inserted or wedged into knife type switches and cut-outs. Especially adapted to test the new type of safety cut-outs.

The extension leads make possible testing of lines or terminals across very wide spaces.

NO. 34-005 Test-Lite and Fuse Puller only.
NO. 34-006 One 18" Flexible Lead

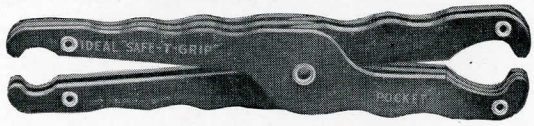


Tool being used as Fuse Puller.



Tool being used as Test-Lite.

"SAFE-T-GRIP" FUSE PULLERS



Patent Pending

No Slip! Formed To Fit the Fingers — Assures a Positive, Full Grip.

Safe—Handy—Inexpensive! Belong in easy reach in every fuse box. IDEAL Fuse Pullers eliminate the danger of pulling and replacing cartridge fuses by hand, and the bending of fuse clips through improper removal. Also adapted for adjusting loose cut-outs clips, handling laboratory test tubes, live electrical parts, etc.

Rugged Laminated Construction

IDEAL Standard Fuse Pullers are of rugged laminated fibre construction, an assurance of mechanical strength, lightness and durability. Possess high di-electric qualities and ability to withstand exceptional atmospheric conditions of heat and humidity. NEW AND IMPROVED DESIGN—formed to fit the fingers, assuring a positive—non-slip grip.

IDEAL Fuse Pullers are approved as standard by safety departments of many industrial and utility plants.

Special Types—made of laminated Bakelite in "Safe-T-Grip" design are also available in "Pocket" and "Giant" sizes.

Four Handy Sizes

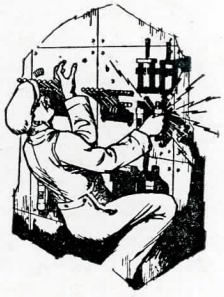
"MIDGET" SIZE NO. (34-001)
3 laminations, 5" long. For handling small fuses, grid leaks, etc. ¼" to ½" in diameter. (Formerly Catalog No. 3) Weight 1 oz.

"POCKET" SIZE (NO. 34-002)
5 laminations, 7½" long. For fuses 0 to 200 amps., 250 volts; and 1 to 100 amps., 600 volts—from ½" up to 1½" diameter. (Formerly Catalog No. 5) Weight 3 ozs.

"GIANT" SIZE NO. (34-003)
7 laminations, 12" long. For handling fuses 100 to 600 amps., 250 volts; and 60 to 400 amps., 600 volts—from 1" up to 2½" diameter. (Formerly Catalog No. 7) Weight 8 ozs.

"JUMBO" SIZE NO. (34-004)
9 laminations, 20" long. For handling fuses 200 to 800 amps., 250 volts; and 200 to 600 amps., 600 volts—from 1½" up to 3" diameter. (Formerly Catalog No. 9) Weight 24 ozs.

The right SAFE IDEAL way.

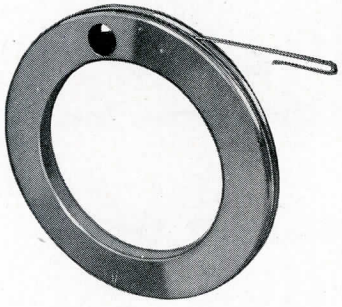


The wrong dangerous way.

See Hints and Tables, Pages 71 to 88

FISH TAPE, REELS AND PULLERS

"3 TOOLS IN ONE"



Patented No. 1,890,945

Speed Wiring — Save Tape!

Makes Fishing A Pleasure!

A handy device that belongs in every wireman's kit along with the pliers, cutters and screw-driver. Gives complete control of the Fish Tape—one thing that has usually been out of control.

The IDEAL Fish Tape Reel and Puller gives a *big pulling power*—impossible with a hand hold or pliers. Easy to handle and keeps the Tape within the Reel, preventing breaking, and springing all over the job.

Eight Stock Sizes

of complete Fish Tape, Reels and Pullers

Catalog Number	Former Number	*Length and Size Tape*		
31-007	00	50'	1/8"x.045"	(3/64")
31-008	0	50'	1/8"x.060"	(1/16")
31-009	1	100'	1/8"x.060"	(1/16")
31-010	2	100'	3/16"x.060"	(1/16")
31-011	3	100'	1/4"x.060"	(1/16")
31-012	4	100'	1/8"x.030"	(1/32")
31-013	5	100'	3/16"x.030"	(1/32")
31-014	6	100'	1/4"x.030"	(1/32")

NOTE: For Reels with longer Tapes, see below.

MAXIMUM CAPACITY OF REELS (CASES)

Reel No.	Length and Size of Tape
No. K-358	50' of 1/8"x.045" Tape
No. K-266	50' of 1/8"x.060" Tape
No. K-65	200' of 1/8"x.060" Tape
No. K-987	150' of 3/16"x.060" Tape
No. K-988	100' of 1/4"x.060" Tape
No. K-65	400' of 1/8"x.030" Tape
No. K-987	300' of 3/16"x.030" Tape
No. K-988	250' of 1/4"x.030" Tape

NOTE: When ordering Reels with longer tapes, specify Reel Number and length of Tape desired.

Many Advantages

Serves as a handle and pulling device. Gives a perfect hold on the Fish Tape. Makes it easy to pull tape through conduit quickly and without kinks, bends or breaks. No slipping. Fits any size hand.

The coil of steel tape is *securely held* in the Reel at all times, but can be instantly and rapidly run out to any length for use on the job.

Maintains constant tension on the tape and thus prevents kinking. Has plenty of spring even after long use.

Protects tape from breaking by keeping it enclosed. Automatically locks the end of tape in place to keep it from unwinding.

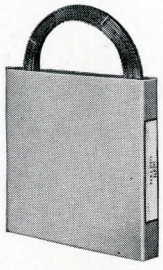
Keeps the tape reeled up—enables the workman to avoid contact with "live" parts—and avoids having the tape spread out all over the job, thereby *saving expensive and continuous breakage.*

Saves 50% of the time required for "fishing" in the old way, as the tape is reeled or unreeled and pulled through the conduit in one operation.

Reel keeps tape securely held at all times—easy to reel in or pay out.

Reel gives a BIG grip, permits user to exert full strength.

FISH TAPES



Made of highest grade tempered spring steel wire—non-curling. Flexible and easy to use on long runs of conduit, having several bends. All sizes available in any length, multiples of 50' up to and including 300', or in multiples of 100' for longer tapes.

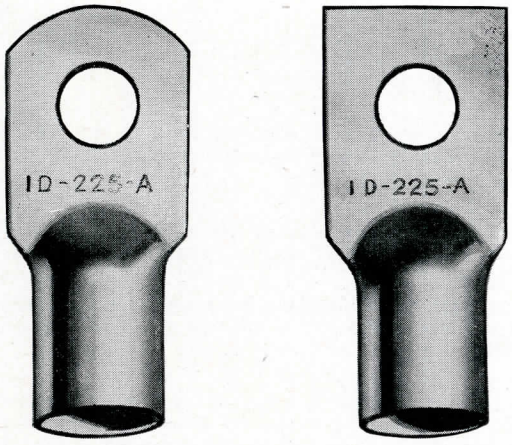
Cat. No.	*Width*	*Thickness*	*Cat. No.*	*Width*	*Thickness*
14-T	1/8"	.060"	11-T	1/8"	.030"
15-T	3/16"	.060"	12-T	3/16"	.030"
16-T	1/4"	.060"	13-T	1/4"	.030"

No. 14-T—1/8"x1/16" Fish Tape available in 5,000' lots, not wrapped or packed in individual cartons.

NOTE: All sizes can be assorted in standard coil lengths of 100', 150' and 200' to obtain QUANTITY prices.

See Hints and Tables, Pages 71 to 88

SOLDER LUGS



APPROVED — Listed by Underwriters' Laboratories, Inc.

18 SIZES — 25 to 1050 AMPS.

Side Formed
Square Or Round Ends

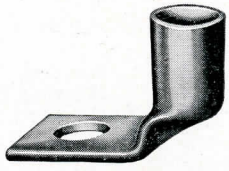
IDEAL Heavy Duty Soldering Lugs are made of high quality pressed copper. Contact surfaces are smooth and flat for maximum conductivity—low resistance. Lugs are bright and clean—no sharp edges or burrs. *Uniform size.*

Ampere rating is plainly stamped on each lug to avoid mistakes—speed work. Made with side formed square or round ends as desired. Square end lugs are recommended, as they have more contact surface than round end lugs.

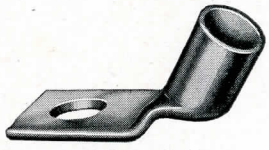
Special Lugs

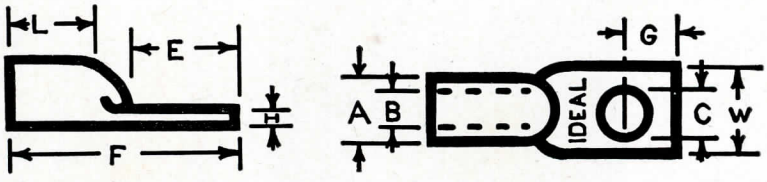
To meet particular conditions, IDEAL Lugs are also available with stud hole of special size or location; longer or shorter length; annealed to permit bending; cadmium plated; rosin dipped or tinned; ground flat surfaces; rosin dipped or tinned inside only.

TWO HOLE SOLDERING LUGS are made in 18 sizes, the same as standard one hole Lugs. Dimensions are approximately the same, except length. Made to same high standards of workmanship and material.


90° Angle Lug

45° AND 90° ANGLE LUGS have same dimensions as single hole lugs, except length which is slightly shorter.


45° Angle Lug



NOTE: Square End Lugs are recommended as they have more contact surface than Round End Lugs. Square end Lugs supplied unless otherwise specified.

Catalog No. Square End	Catalog No. Round End	Size	Amp. Rating N. E. C.	MAX.—B. & S. (A. W. G.) STRANDED WIRE	ROUND AND SQUARE END								Wgt. Per 1,000	Std. Carton
					B	C	E	F	**G	W	H	L		
													(Lbs.)	
29-041	29-001	5/16	25	10	.140	11/64	15/32	7/8	15/64	17/64	.047	5/8	4	250
29-042	29-002	1/4	35	8	.186	13/64	1/2	1	13/64	3/8	.064	3/8	6	200
29-043	29-003	5/16	50	6	.240	13/64	19/32	1 3/16	1/4	7/16	.072	3/8	11	200
29-044	29-004	3/8	70	4	.295	9/32	11/16	1 11/32	9/32	17/32	.080	7/16	17	125
29-045	29-005	7/16	90	2	.347	9/32	3/4	1 9/16	11/32	5/8	.090	1/2	24	100
29-046	29-006	1/2	†125	0	.405	17/64	13/16	1 3/4	13/32	3/4	.095	5/8	35	100
29-047	29-007	9/16	150	00	.462	13/32	15/16	2	7/16	13/16	.100	11/16	46	100
29-048	29-008	5/8	175	000	.520	13/32	1	2 1/8	15/32	29/32	.105	25/32	60	100
29-049	29-009	11/16	225	0000	.565	13/32	1 5/32	2 5/16	17/32	31/32	.122	27/32	70	50
29-050	29-010	13/16	250	250,000 CM	.668	13/32	1 1/4	2 3/4	5/8	1 3/16	.144	31/32	70	25
LUGS LISTED BELOW SQUARE END ONLY														
29-033	.....	15/16	325	400,000 CM	.778	13/32	1 5/8	3 3/8	3/4	1 13/32	.159	1 3/16	225	Bulk
29-034	.....	1	362	450,000 CM	.836	13/32	1 3/4	3 7/16	13/16	1 1/2	.164	1 1/4	285	Bulk
29-035	.....	1 1/16	‡400	500,000 CM	.875	13/32	2 1/8	4 1/16	15/16	1 9/16	.187	1 1/2	370	Bulk
29-036	.....	1 1/8	450	600,000 CM	.943	17/32	2 1/4	4 7/16	1	1 11/16	.182	1 5/8	410	Bulk
29-037	.....	1 5/16	550	800,000 CM	1.120	17/32	2 1/2	5	1 1/8	1 15/16	.192	2	715	Bulk
29-038	.....	1 7/16	650	1,000,000 CM	1.217	25/32	2 1/2	5 3/8	1 5/16	2 1/8	.220	2	790	Bulk
29-039	.....	1 3/4	850	1,500,000 CM	1.460	11/32	3 1/8	6 5/8	1 7/16	2 5/8	.290	2 3/8	1470	Bulk
29-040	.....	2 1/16	1050	2,000,000 CM	1.750	11/32	3 5/8	7 1/2	1 5/8	3 1/16	.312	2 5/8	2760	Bulk

See Hints and Tables, Pages 71 to 88

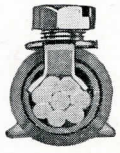
"SCREW-TITE" (Solderless) LUGS

APPROVED—Listed by Underwriters' Laboratories, Inc.

Quickly Attached With Screw-Driver or Wrench
NO SOLDER—NO SPECIAL TOOLS are needed!

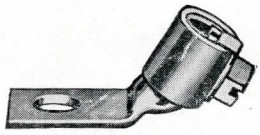
IDEAL "Screw-Tite" Lugs are quickly and securely attached with screw-driver (sizes 35 to 70), and with wrench, (sizes 125 to 1050.) Compare in size to ordinary lugs.

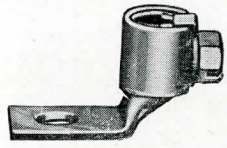
Made of seamless, pure electrolytic copper, accurately pressed for uniform size. Heavy brass, check proof shell reduces heating. All Lugs are smooth and free from burrs. Flat contact surfaces assure minimum resistance. Full carrying capacity evenly distributed from wire to lug—no metal cut away to reduce capacity.



45° and 90° angle "Screw-Tite" Lugs also available. Dimensions are identical with straight lugs, except for overall length (F). Other special lugs can also be made to order. When ordering lugs with other than standard hole and of special dimensions, be sure to give complete specifications, including a dimension drawing, if possible.

NOTE: Square End Lugs are supplied on order, unless otherwise specified. Square End Lugs are recommended as they have more contact surface than Round End Lugs.

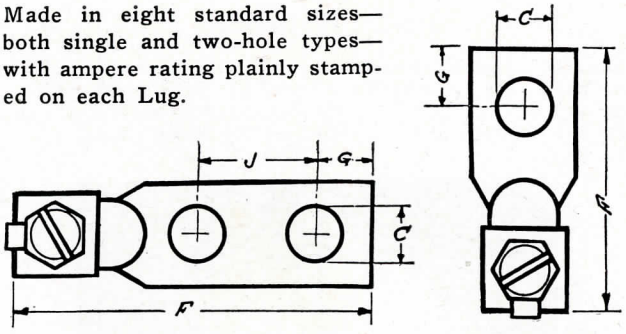

45° Angle Lug.


90° Angle Lug.

ONE HOLE TYPE—SQUARE END

Cat. No.	Amp.	Max.-Min. Wire Size (B&S) (AWG)	Wgt. per 1000 (lbs.)	Std. Carton	DIMENSIONS F	C	G
29-051	35	8 to 14	11	250	1 1/32	13/64	13/64
29-052	70	6 to 4	31	200	1 13/32	9/32	9/32
29-053	125	2 to 0	70	100	1 13/16	9/32	5/8
29-054	225	00 to 0000	149	25	2 3/8	13/32	17/32
29-055	400	400,000 to 500,000-C.M.	625	10	4 5/16	13/32	3/4
29-056	650	700,000 to 1,000,000-C.M.	1250	4	5 3/8	17/32	13/16
29-057	850	1,500,000-C.M.	3500	4	6 5/8	1 1/32	1 7/16
29-058	1050	2,000,000-C.M.	4500	4	7 1/2	1 1/32	1 5/8

Made in eight standard sizes—both single and two-hole types—with ampere rating plainly stamped on each Lug.



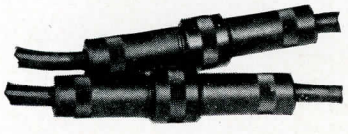
TWO HOLE TYPE—SQUARE END

Cat. No.	Amp.	Max.-Min. Wire Size (B&S) (AWG)	Wgt. per 1000 (lbs.)	DIMENSIONS F	C	G	J
29-060	35	8 to 14	17	1 13/16	5/16	5/16	7/16
29-061	70	6 to 4	46	1 7/8	9/32	5/16	5/8
29-062	125	2 to 0	105	2 5/8	11/32	3/8	7/8
29-063	225	00 to 0000	223	4	13/32	5/8	1 1/4
29-064	400	400,000 to 500,000-C.M.	937	5 1/4	17/32	13/16	1 1/2
29-065	650	700,000 to 1,000,000-C.M.	1875	7 1/4	29/32	1 1/8	2
29-066	850	1,500,000-C.M.	5250	8 5/8	1 1/32	1 3/8	2 1/4
29-067	1050	2,000,000-C.M.	6750	9 1/4	1 1/32	1 1/2	2 1/4

Nos. 29-053 and 29-062 can be furnished with 11/32" or 13/32" hole.
No. 29-064 furnished with 17/32" hole when specified on order.

CABLE CONNECTORS

Quick "Make-and Break" . . . Two (2) Piece—For Joining Cables End to End



Save time and money! Easily installed in power supply lines to machinery and electrical apparatus. Quick "make-and-break." Cables may be joined or taken apart in a jiffy. The brass male and and female parts are simply pressed together and securely held by insulating fibre cover. Connector halves attach to cable by screwing on—just like a "nut on a bolt." Weight 8 ounces each.

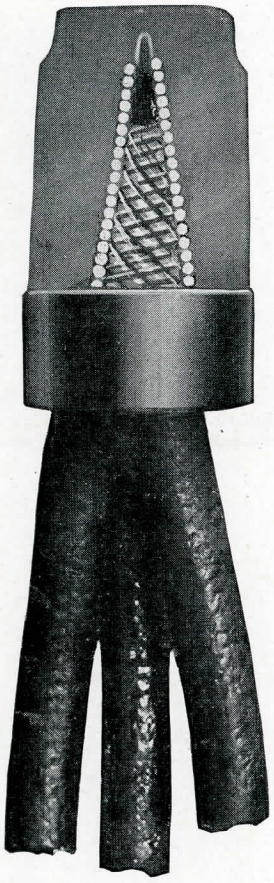
CATALOG NO. 28-001 For Nos. 9 and 8 Cable

CATALOG NO. 28-005 For Nos. 3 and 2 Cable

See Hints and Tables, Pages 71 to 88

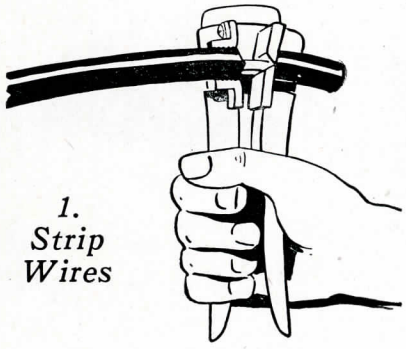
SOLDERLESS - TAPELESS **Wire-Nut** WIRE CONNECTORS

Patented No. 1,700,985

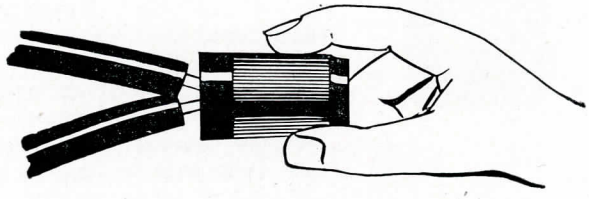


Make Better wire joints . . . faster and at a lower cost! Fully Approved

To Use, Simply . . .



1. Strip Wires



2. Screw On . . . . THAT'S ALL!

Millions of IDEAL "Wire-Nuts" are used by plant electricians and wiring contractors for roughing-in and fixture hanging—by appliance manufacturers for making all kinds of permanent joints—by sign makers for quick, easy and lasting joints in close quarters—by radio set builders and others to replace solder and tape, plus connections, terminal blocks, binding posts, eyelets, etc.

For Solid or Stranded Wire Sizes for Joining 2 No. 18 to 3 No. 10

"Wire-Nuts" make a stronger wire joint mechanically, a better joint electrically. Eliminate the waste of time, bother and the danger of making soldered joints with a blow torch. Five sizes for making all common wire combinations (see page 53).

"Wire-Nuts" consist of a cone shaped spiral spring insert, imbedded in molded insulation. They thread onto the skinned wires, just like a nut threads onto a bolt. The tapered spring insert, into which the wires fit, twists and compresses the wires tighter and tighter together as the Connector is turned; and at the same time thread marks are pressed *(not cut)* into the wires, which hold wire and Connector securely together.

STRONGER MECHANICALLY—The strength of a soldered joint of 2 No. 14 solid wire is 57 lbs. against pull. The same size joint made with an IDEAL No. 74 "Wire-Nut" will stand a 176 lb. pull.

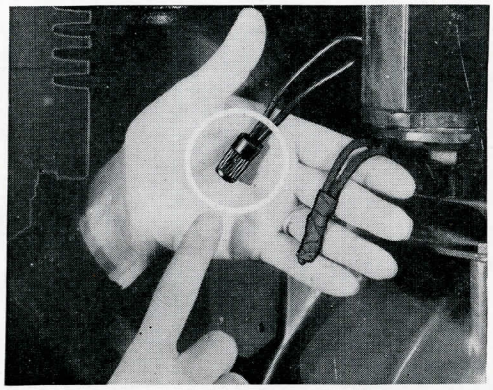
BETTER ELECTRICALLY—A soldered joint of 2 No. 14 wire shows .004 ohms resistance. The same size joint made with an IDEAL No. 74 "Wire-Nut" shows .0031 ohms resistance.

IDEAL "Wire-Nut" Joints are highly resistant to heat and vibration.

NON-CORROSIVE—Corrosion is eliminated through the spring pressing threads into the wires, since corrosion cannot take place in self-made threads with a Connector in place.

Fully Approved

IDEAL "Wire-Nuts" are approved by Underwriter's Laboratories, Inc., and approved by Factory Mutual Laboratories. Recommended by the National Electric Code and other *Leading Electrical Authorities everywhere.*



COMPARE THE DIFFERENCE—You'll agree that IDEAL "Wire-Nuts" are far superior to old-fashioned solder and tape connections.

SOLDERLESS - TAPELESS **Wire-Nuts** WIRE CONNECTORS

Patented—No. 1,700,985

FOR USE IN GENERAL PLANT WIRING

Electrical wiring in the industrial plant is greatly simplified with IDEAL "Wire-Nuts", for no solder, tape, flux, soldering iron or torch are needed. A pocket-full of "Wire-Nuts" and a Wire Stripper does the job.

Their value is especially realized when making changes, such as adding new circuits, making temporary installations and re-locating machinery. There's no fussing—"Wire-Nuts" are simply unscrewed like taking a nut off a bolt, and they may be screwed on again after the change is made.

Sizes For Every Purpose

No. 74 and No. 76 "Wire-Nuts" are most generally used for industrial wiring as they take care of all common combinations of No. 10, No. 12, No. 16 and No. 18 wire. However, when hanging fixtures and making smaller wire joints, the Nos. 72 and 73 "Wire-Nuts" are mighty handy.

The joint is made by first stripping the wires about ½", then while holding the wire ends together (no twisting necessary), simply slip the "Wire-Nut" over the wire ends and screw it on.

Make Dependable Joints

IDEAL "Wire-Nut" joints are safe, trouble-free and permanent. The inner cone shaped spiral spring acts as a current carrying sleeve, making a superior joint—electrically.

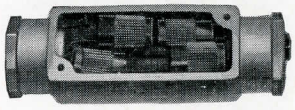
As the connector is twisted on to the wires, the spring insert automatically compresses the wires and twists them together in one operation. In the same motion, clean threads are *pressed* (not cut) into wires—making a joint that will stand up under several times the pull that the best soldered joint will withstand.

Free Samples on Request

The molded insulation of IDEAL "Wire-Nuts" eliminates any possibility of sharp wire ends protruding and piercing as is common with solder and tape joints. Prevents failure of insulation through continuous rubbing.

Safe—Eliminate Fire and Explosion Hazard

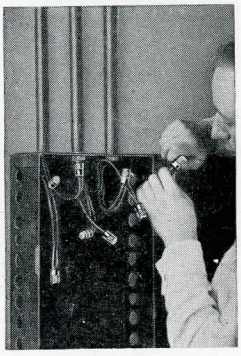
The safest and best device to use under hazardous conditions. Recommended by electrical and inspection authorities.



"Like Peas in a Pod" Wire-Nuts occupy very little space.

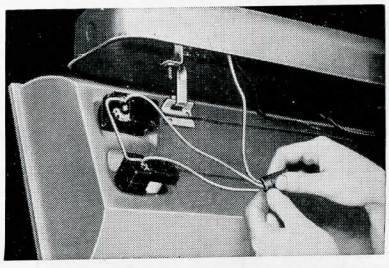
Not A Substitute

IDEAL "Wire-Nuts" are not a substitute for solder and tape. "Wire-Nuts" make better joints faster! IDEAL "Wire-Nuts" have been used in continuously increasing quantities for years.

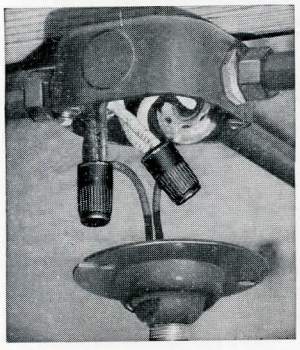


Roughing-in work speeded up by joining wire ends with "Wire-Nuts" when pulling wire through conduit.

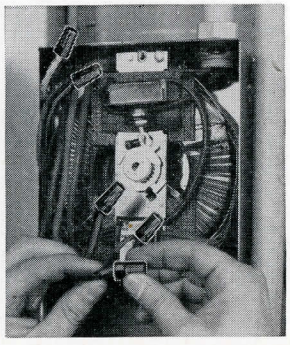
MILLIONS IN USE!



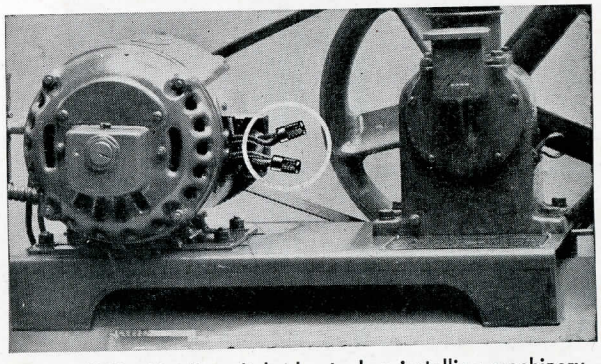
IDEAL'S speed up installation of fluorescent and other lighting fixtures.



Simplifies hanging of fixtures and installation of electrical equipment.



"Wire-Nuts" used in installation of Unit Heater—speeds work.



IDEAL "Wire-Nuts" can't be beat when installing machinery. Easily unscrewed and used again when making changes.

See Hints and Tables, Pages 71 to 88

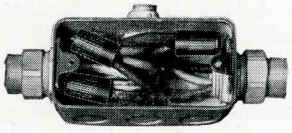
SOLDERLESS - TAPELESS

Wire-Nuts

WIRE CONNECTORS

Patented—No. 1,700,985

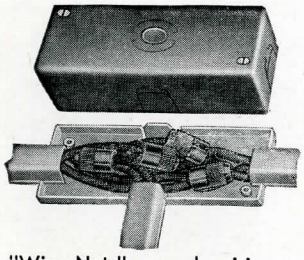
FOR USE IN NEW BUILDING CONSTRUCTION



IDEAL "Wire-Nuts" Require Little Space — compact and neat.

The many advantages of "Wire-Nuts" — electrically and mechanically, plus the fact that they *speed up wiring,* are the reasons why thousands of Electrical Contractors everywhere have standardized on IDEAL Connectors.

On the average job it takes less than a minute to make a "Wire-Nut" joint. Subtract that from the long time required for solder and tape—multiply by five . . . ten . . . twenty —or a hundred thousand wire joints, and that's how easy it is to beat contract dates!



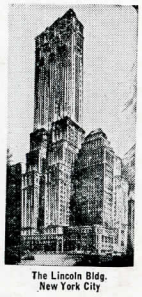
"Wire-Nuts" speed wiring—require no special tools.

Millions of IDEAL "Wire-Nuts" are used for roughing-in and fixture wiring in industrial plants, hotels, public buildings, bridges, tunnels, schools, private homes, etc.

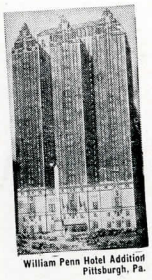
Contractors prefer "Wire-Nuts" because they completely eliminate the flame-spouting torch, hot soldering iron, messy tape and molten solder with its personal injury hazards. Puts an end to scorched woodwork—blackened walls and ceilings.

IDEAL "Wire-Nuts" are *fully approved.*

Philadelphia Fidelity Trust Bldg., Philadelphia, Pa.

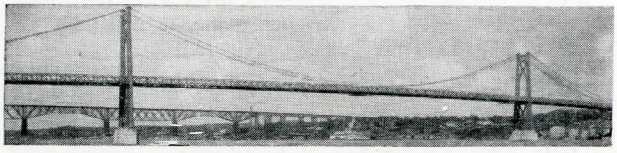


The Lincoln Bldg. New York City



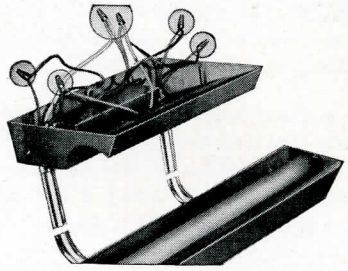
William Penn Hotel Addition Pittsburgh, Pa.

Millions of solderless-tapeless connectors are used in electrical construction. Save time and money.



"Wire-Nuts" are the SAFE wire joint on jobs like this, for they are not affected by heat, cold, or vibration.

FOR MANUFACTURERS USE IN NEW PRODUCTS



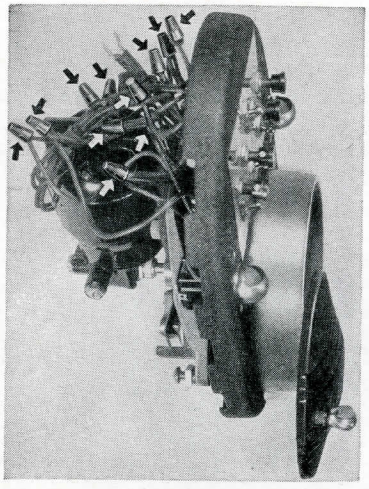
Speed Production— Improve Quality— Cut Costs!

Modern Connectors used in a modern lamp. Make a neat, dependable wire joint in minimum time.

The use of IDEAL "Wire-Nuts" is especially vital in manufacturing where the saving of even a fraction of a cent may mean success or failure. The "four joints per minute" speed of Wire-Nuts *steps up production schedules* and makes them more flexible. And because "Wire-Nuts" are so easy to use, even by inexperienced help, skilled workers can be released for more important assembly work.

Other savings are often effected by using IDEAL "Wire-Nuts" instead of binding posts and terminal blocks. Save the cost of eyeletting leads, mounting of terminals, etc. When replacing solder and tape, "Wire-Nuts" eliminate the cost of solder, flux, tape and the labor of applying them—the cost of soldering iron or other heating means and its upkeep and cost of current (or heat) used. Also eliminates the bother, delay and possible damage by soldering iron or open flame.

Millions of IDEAL "Wire-Nuts" are being used in lighting fixtures and electrical appliances, tools, fans, motors, clocks, vacuum cleaners, elevator signals, auto appliances, refrigerators, gasoline pumps, vibrating machines, heat regulators, washing machines, switch boards, railway signal equipment, machine tools, ranges, etc.



No soldering iron, tape or fire hazard in making these wire joints—stronger mechanically and electrically.

Free Samples on Request

SOLDERLESS-TAPELESS

Wire-Nuts

WIRE CONNECTORS

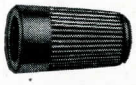
Patented No. 1,700,985

MOLDED "WIRE-NUTS"

All Illustrations Actual Size

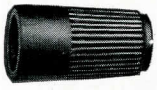
NO. 71 "PRODUCTION" TYPE

For joining combinations of Nos. 16 and 18 AWG solid or stranded wires up to a maximum of 2 No. 16 AWG wires, OR EQUAL COMBINATIONS.



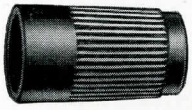
NO. 72 "FIXTURE-APPLIANCE" TYPE

For joining combinations of Nos. 14, 16 and 18 AWG solid or stranded wires up to a maximum of 3 No. 18 AWG wires, one No. 14 and one No. 18, OR EQUAL COMBINATIONS.



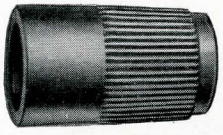
NO. 73 "FIXTURE" TYPE

For joining combinations of Nos. 14, 16 and 18 AWG solid or stranded wires up to 2 No. 14, or five No. 18 AWG wires, OR EQUAL COMBINATIONS.



NO. 74 "STANDARD UNIVERSAL" TYPE

For joining combinations of Nos. 12, 14, 16 and 18 AWG, solid or stranded wires up to a maximum of two No. 12 and one No. 18, or four No. 14 and one No. 18 AWG wires, OR EQUAL COMBINATIONS.



NO. 76 "LARGE UNIVERSAL" TYPE

This Size For All Common Joints.

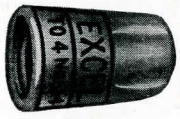
Joins combinations of Nos. 10, 12, 14, 16 and 18 AWG solid or stranded wires up to a maximum of three No. 10 with one No. 18, four No. 12 with one No. 18 AWG wires, six No. 14 with one No. 18, OR EQUAL COMBINATIONS.

EXCEL PORCELAIN

Porcelain "Wire-Nuts" are made in two sizes for fixture hanging and for roughing-in joints, motor connections, etc., made in one piece of the highest grade "white" (unglazed) porcelain or "gray" porcelain.

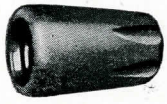
White "Glazed" Porcelain

NO. 3 TYPE—For two No. 18, three No. 18, four No. 18, one No. 14 and one No. 18, solid or stranded wires, OR EQUAL COMBINATIONS.

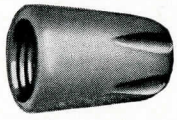


NO. 5 TYPE—For two No. 14, three No. 14, four No. 14, two No. 12, solid or stranded wires, OR EQUAL COMBINATIONS.

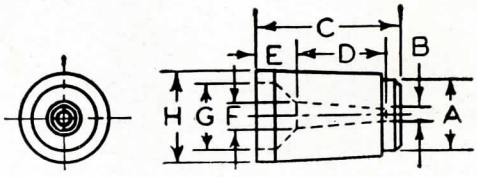
"Gray" Unglazed Porcelain



NO. G-3 TYPE—Same as No. 3 Type, except unglazed and therefore it is less expensive.



NO. G-5 TYPE—Same as No. 5 Type, except unglazed and therefore it is less expensive.



FULLY APPROVED BY—

Underwriters' Laboratories, Inc.
Factory Mutual Laboratories
Electrical Inspectors
Electrical, Building & Material Associations
And other Electrical Authorities

FREE SAMPLES ON REQUEST

Catalog Number	Maximum Wire Combinations A.W.G. Solid or Stranded (or Equal Combinations)	DIMENSIONS IN INCHES A	B	C	D	E	F	G	H	Weight per 1000 (lbs.)	Quant'y in Std. Carton
(Molded) 71	2—No. 16, 3—No. 18	13/64	.040	17/32	5/16	1/8	.105	1/4	21/64	2½	Bulk
72	3—No. 18	9/32	.040	21/32	7/16	1/8	.147	9/32	25/64	5½	100
73	2—No. 14 and 2—No. 18, 4—No. 16, 5—No. 18	11/32	.046	25/32	7/16	15/64	.140	5/16	7/16	7	100
74	2—No. 12 and 1—No. 18, 4—No. 14 and 1—No. 18	1/2	3/64	1	19/32	9/32	11/64	21/64	37/64	18	100
76	3—No. 10 and 1—No. 18, 6—No. 14 and 1—No. 18, 4—No. 12 and 1—No. 18	19/32	7/64	1 1/8	21/32	9/32	1/4	1/2	11/16	30	100
Porcelain 3	1—No. 14 and 1—No. 18	3/8	.025	27/32	11/16	1/32	.275	15/32	17/32	11½	100
5	4—No. 14 or 2—No. 12	1/2	0.90	15/16	7/16	3/8	.175	7/16	5/8	16¼	100

JOIST BORING MACHINE

Comes knocked down, less pipe—ready to assemble on the job.

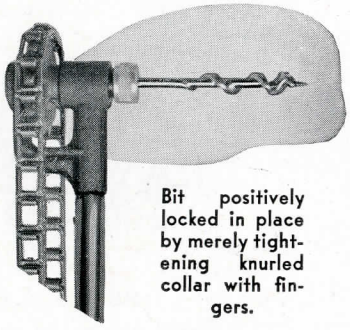
Bores Five (5) Times Faster!

New and Improved Design! Parts only (less pipe) furnished as illustrated. Designed for quick and easy assembly with ½" standard pipe or rigid conduit—complete instructions furnished. May be readily taken apart again and stored in Tool Kit—ready for the next job. With proper length pipe, can be quickly adjusted for overhead work up to 11 or 12 ft.

No stoop—no strain—no ladder hazard! Operates from the floor and easily bores through rafters, joists or studding—*bores five (5) times as fast as a brace or breast drill.* Eliminates climbing up and down; avoids awkward dangerous reaching, straining and bending while standing on a ladder. Gets in and bores where no other tool can be used.

Can be used equally well on new or old floor and ceiling construction. Minimizes waste. The bit eats right into the wood with a light pull on the sprocket chain. Reversing chain brings bit out. Bores at right angles—*saves wire—makes a neater job!*

Easily reaches in between or over obstructions such as tanks, machinery, etc., encountered when working on rewiring jobs. The IDEAL Joist Borer gets in and bores where no other device can be used. Quickly pays for itself!



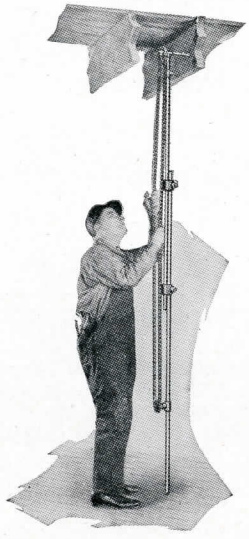
Bit positively locked in place by merely tightening knurled collar with fingers.

Operates from Floor—Saves Back Breaking Effort

NO. 36-001 (Formerly Catalog No. 12). All parts including one 11/16" bit, packed in box, 8"x6"x8". Weight 10 lbs.

NO. 36-003 Extra 12/16" Bit

NO. 36-002 Extra 10/16" Bit



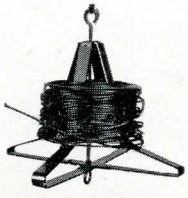
For Overhead Work.

For Floor Work.

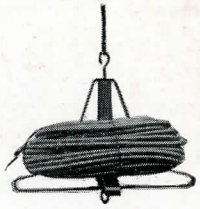
WIRE AND CABLE REEL

Patented—No. 1,929,469

SAVES WIRE—SPEEDS UP WIRING JOBS!



No. 12 Wire



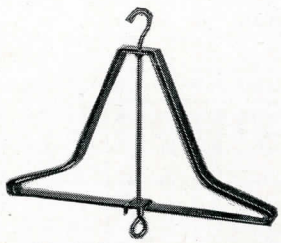
BX Cable

Gives complete control of coiled wire or cable. Handles practically any type coil from 3" to 14" inside diameter, insulated wire from No. 18 to No. 2, electrical cord, rope, armored cable, Romex, binding, etc. Wire may be run out smoothly and easily as desired regardless of angle or speed of pull. Made of ⅛ in. x 1¼ in. steel frame, one part is slightly smaller than other, so that Reel can be completely closed, requiring no more room than ordinary coat hanger. A finger locking device holds Reel open or closed, as desired.

Size: 23¼"x19½"x1⅝" Folded.
23¼"x23¼"x19½" Unfolded.

Hangs Anywhere! A hook at the bottom and an eye at the top makes it easy to hang one, two or more Reels in tandem—from pipe, joist, beam or wherever it's handy.

NO. 31-090 (Formerly Catalog No. 133). Weight, 6½ lbs.



Reel Closed

Reel Open

ELECTRIC MARKER

This small powerful Marking Tool cuts its mark permanently in ANY KIND OF MATERIAL!

USED LIKE A PENCIL

OPERATES FROM ANY ALTERNATING CURRENT OUTLET

MAKES 7200 CUTTING STROKES PER MINUTE!

INEXPENSIVE!

Easily Marks These Materials—

Alloys	Aluminum	Plastics
Steel	Ceramics	Bakelite
Iron	Tile	Porcelain
Bronze	Wood	Hard Rubber
Brass	Copper	Wall Board
Marble	Lead	Glass, etc.

Used like a pencil, this powerful little Marker permanently makes a mark wherever you want it. Cuts right into the surface, leaving lines that cannot be wiped away or worn off with ordinary usage.

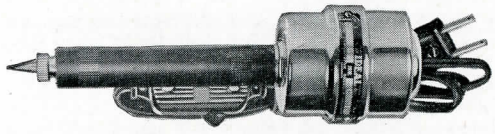
Innumerable Uses

The IDEAL Marker operates from any AC electrical outlet—can be used anywhere! It's *ideal* for marking stock, part numbers and sizes; Brinnel and Rockwell hardness; kind of material; manufacturer's trade name; model, voltage, or other information regarding use; for identifying parts and equipment in warehouses, laboratories and storerooms; for permanently marking owners' names on tools in the shop or toolroom; for writing on nameplates, glass, plastic-ware, etc.

Using the Marker decreases theft, and loss of expensive, hard-to-get tools. It saves an endless number of mistakes that occur because of lack of permanent identification of materials, parts and products.

Available With Diamond Point

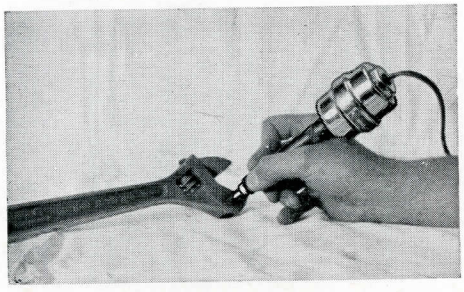
The complete Marker is only 6⅝" long — is entirely self-contained, ready for use. Weighs only 16 ounces.



A Hardened Steel Point is furnished for ordinary usage while for marking extra hard materials up to 60 Rockwell, Scale C, a Diamond Point is recommended. (Formerly Catalog No. 3).

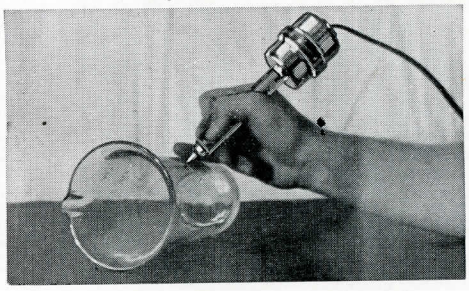
NO. 14-001	With Steel Point	115V, 60 Cy.
NO. 14-003	With Steel Point	230V, 60 Cy.
NO. 14-002	With Steel Point	115V, 50 Cy.
NO. 14-004	With Steel Point	230V, 50 Cy.
NO. 14-026	With Diamond Point	115V, 60 Cy.
NO. 14-027	With Diamond Point	230V, 60 Cy.
NO. 14-028	With Diamond Point	115V, 50 Cy.
NO. 14-029	With Diamond Point	230V, 50 Cy.

EXTRA POINTS Steel, No. L-378; Diamond, No. L-624.



Marking owner's name on tool—prevents theft.

Actual photograph of mark on Masonite drill jig.

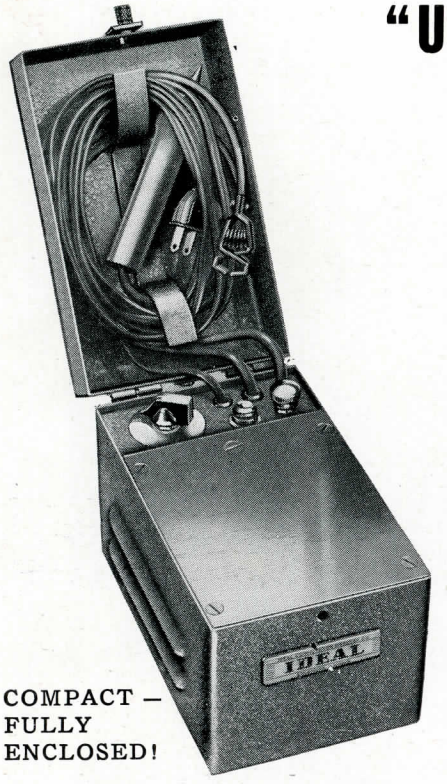


Marking on glass—mark is permanent.

See Hints and Tables, Pages 71 to 88

"UNIVERSAL" ELECTRIC ETCHER

The All Purpose Etcher



COMPACT — FULLY ENCLOSED!

PATENT PENDING

PERMANENTLY MARKS SIZES, NAMES, NUMBERS AND OTHER IMPORTANT INFORMATION ON

Parts	Tools	Dies
Chasers	Gauges	Bits
Sleeves	Adaptors	Jigs
Arbors	Forming Tools	Equipment
Punches	Reamers	Fixtures

Electrically Marks All Iron, Steel and Their Alloys

Permanent identification minimizes loss and theft of costly, hard-to-get tools and instruments. Permanent marking of materials and parts avoids confusion and mistakes; etching trade-name on products eliminates the cost and delay in obtaining precious metal nameplates and tags—SAVES CRITICAL MATERIALS.

Anything made of Steel, Iron or Their Alloys can be quickly and easily marked with the IDEAL "Universal" Etcher. Regardless of hardness of metal, it burns right into the surface making a smooth and permanent mark.

Easy To Use

Portable—everything is completely enclosed in a compact, attractive case. No looking for misplaced parts, no separate parts to connect and adjust, no protruding contacts. It's ready for use in a split second—just raise the top and plug in. The cover can be detached if desired. To etch small tools and parts, simply place them on the Work Plate, turn switch "on" to proper heat and start etching.

A Ground Clamp is provided for etching parts too large for the Work Plate. Simply clamp to part and etch as before.

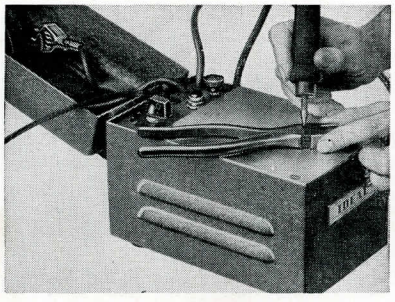
Many Features Small Etching Tool Available

Four Etching Heats—120, 240, 420 and 700 watts makes the "Universal" model ideal for etching small tools, as well as larger parts. In addition to the four ounce standard etching tool, regularly furnished, a *two ounce small etching tool* is available for marking delicate, thin metal parts.

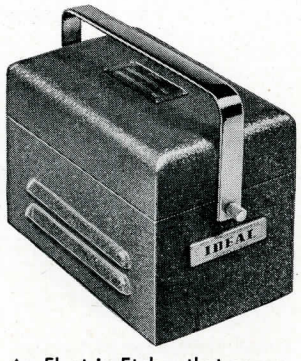
A red lamp indicates when power is "on" and burns brighter as each higher heat is used. Depth of mark can also be controlled by speed of writing. Has 5' cord and plug, ground clamp with 4 ft. lead, overall size 7¼"x5⅛" x8½". Work plate is renewable. Weight only 16 lbs. (Formerly Catalog No. 13).

NO. 11-029	115V, 50-60 Cy.
NO. 11-030	230V, 50-60 Cy.
NO. 11-031	115V, 25 Cy.
NO. 11-032	230V. 25 Cy.

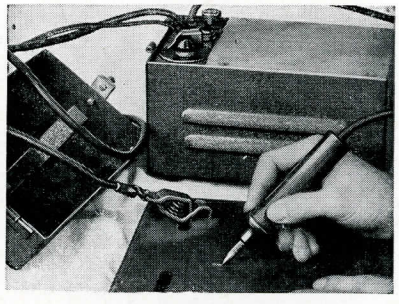
NO. 11-045	Small Etching Attachment
NO. R-247	Extra Standard Etching Point
NO. L-1744	Extra Small Etching Point



Convenient to use. Simply open cover and start etching.



An Electric Etcher that anyone can be proud to own.

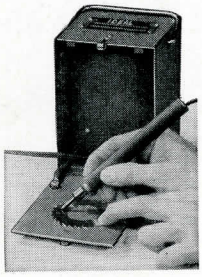


Cover removed—using ground clamp to etch large part.

See Hints and Tables, Pages 71 to 88

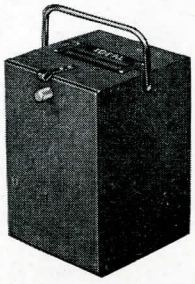
"THIN-LINE" ETCHER

For Etching Small Parts



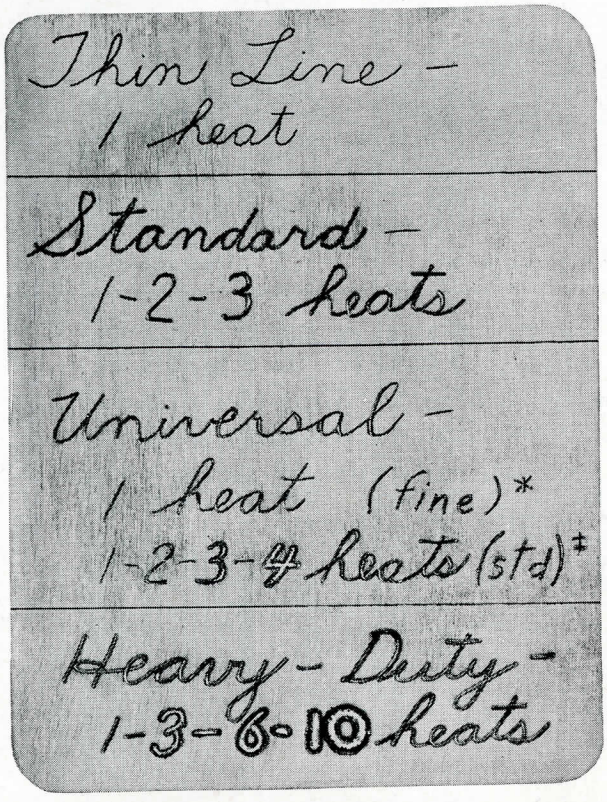
As the name implies, the IDEAL "Thin-Line" Electric Etcher is especially designed for engraving small tools and parts. It's just as easy to use as an ordinary lead pencil and permanently marks on smooth surfaced iron, steel and their alloys. Has one heat only, depth of mark is governed by speed of movement of etching tool.

All parts are fully enclosed and out of the way when not in use. When there is something to etch—simply release the cover front and it drops down to become a work plate. The handpiece and cord are inside—that's all there is to it. Recommended for intermittent use only.



The complete unit includes 5' primary cord and plug; two ounce *heat-resisting etching tool* with 3' lead; 4"x6" workplate. Etching heat, 125 watts. Size — only 4¼" x 4¼" x 7". Weight, 5¼ lbs. (Formerly Catalog No. 9).

NO. 11-001	115V, 50-60 Cy.
NO. 11-002	230V, 50-60 Cy.
NO. 11-003	115V, 25 Cy.
NO. 11-004	230V, 25 Cy.
NO. L-1744	Extra Etcher Points

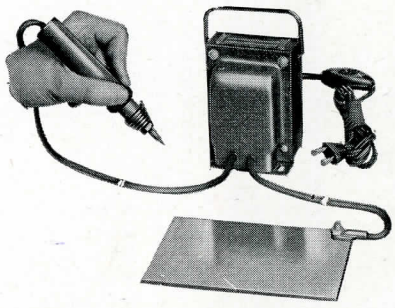


* Using small etching tool
‡ Using standard etching tool

Comparison of marks made by all sizes of IDEAL Etchers. Metal is cold rolled steel.

"STANDARD" ETCHER

For Medium Size Work



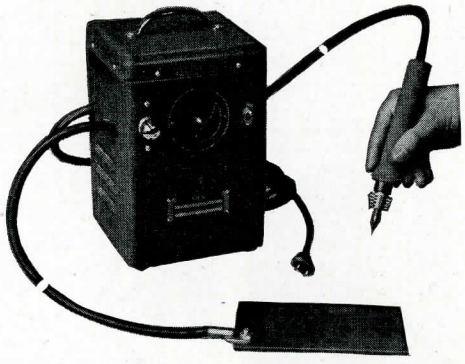
This model is especially popular for lighter applications. Three (3) heats—140, 205 and 375 watts—provide convenient adjustments for etching small and medium size objects. Work plate and etching tool have 5' leads. When etching large objects, the work plate can readily be replaced with ground clamp.

Includes four ounce etching tool with *heat-resisting handle,* and special alloy point; 4"x7" work plate; three heat power unit and primary cord with heat changing switch. Weight, 12 lbs.

NO. 11-009	115V, 50-60 Cy.
NO. 11-010	230V, 50-60 Cy.
NO. 11-011	115V, 25 Cy.
NO. 11-012	230V, 25 Cy.
NO. R-247	Extra Etcher Points

"HEAVY DUTY" ETCHER

For Etching Large Parts



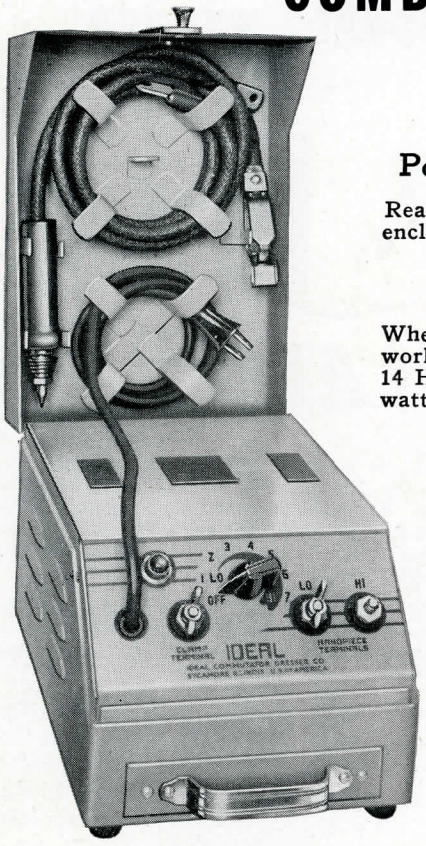
This *powerful* marking tool has "what it takes" for making permanent identifications on smooth castings, big parts, and other large smooth surfaced metal objects. Etching heats vary in 100 watt steps from 300 to 1100 watts. Top heat is 1300 watts. Prominence of marking is governed by heat used and speed at which point travels over metal.

Unit includes heavy duty power unit with ten tap switch, "on-off" switch indicating lamp; large ground clamp; 6 ounce *heat-resisting etching tool* and 4"x7" work plate. Weight, 30 lbs.

NO. 11-017	115V, 50-60 Cy.
NO. 11-018	230V, 50-60 Cy.
NO. 11-019	115V, 25 Cy.
NO. 11-020	230V, 25 Cy.
NO. L-887	Extra Etcher Points

See Hints and Tables, Pages 71 to 88

COMBINATION ETCHER-DEMAGNETIZER



An Invaluable Piece of Equipment in Any Tool Room or Machine Shop.

Portable--All Parts Enclosed in Attractive Carrying Case

Ready for instant use, as either an Etcher or Demagnetizer. All parts conveniently enclosed when not in use.

Etching

When etching, the cover may be tilted back or entirely removed, if desired. Size of work-plate is 8¾"x7¾", a cable and ground clamp is furnished for very large work. 14 Heats (Lo—90, 150, 200, 250, 350, 450, 600; Hi—300, 400, 500, 650, 850, 1100, 1350 watts) are provided by "Hi-Lo" tap and 7 point switch. This gives a wide range for marking all iron, steel and their alloys from small delicate parts up to large smooth castings. When using ground clamp to etch large parts, the "keeper" must be removed from front of case and placed on work-plate across transformer poles. Indicating lamp glows brighter as higher heat is used.

Inexpensive!

Convenient—Cover removable if desired.

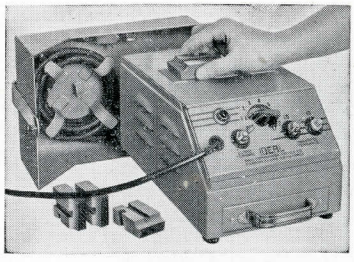
Demagnetizing

To demagnetize, it is only necessary to turn switch "on" to either No. 1 or No. 2 position and proceed as with ordinary demagnetizer. (See page 59). Maximum rating is 5.5 ampere. Overall pole area, 13½ square inches.

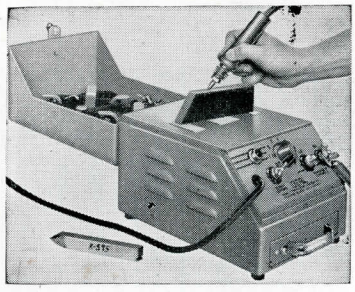
Specifications

Overall dimesions only 8¼" x 11½" x 8⅝". Includes 5' primary cord and plug, heat-resisting etching tool with 5' lead, extra point, ground clamp and 4' lead. Weight, 39 lbs.

NO. 11-052	115v., 50-60 cy.
NO. 11-053	230v., 50-60 cy.
NO. 11-054	115v., 25 cy.
NO. 11-055	230v., 25 cy.
NO. L-887	Extra Alloy Point



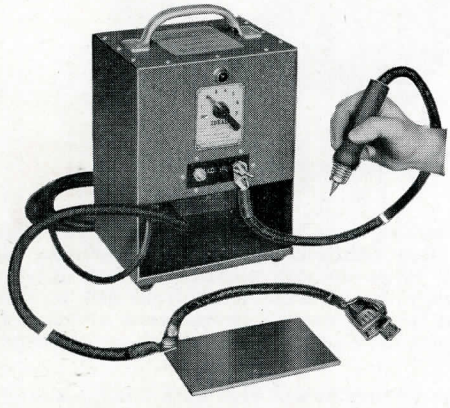
Used as Demagnetizer.



Used as Etcher.

MACHINE SHOP ETCHER

Designed Especially for Machine Shop Use—Electrically Marks Tools, Dies, Gauges, Reamers, Bits, etc.



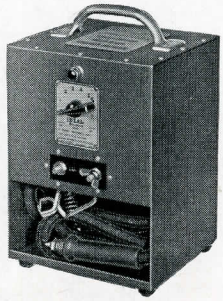
14 Heats!

Saves time, prevents mistakes in use of material, parts, tools, etc. Lessens theft and loss. Regardless of the hardness of tool or part, it can be easily etched. There is no sticking to metal as with ordinary etchers, for IDEAL provides heat control. Writes on iron, steel and their alloys.

Etching Heats: Lo-115, 150, 175, 200, 260, 320, 380 watts; Hi-320, 410, 500, 275, 860, 1050, 1300 watts. The complete unit includes heavy duty transformer; 5 ounce special heat-resisting etching tool with heat radiating fins; alloy tip etching point; heavy asbestos secondary cable; 4"x7" work-plate with ground clamp attachment. Maximum rating 1300 watts. Weight, 32 lbs.

(Formerly Catalog No. 18).

NO. 11-048	115V., 50-60 Cy.
NO. 11-049	230V., 50-60 Cy.
NO. 11-050	115V., 25 Cy.
NO. 11-051	230V., 25 Cy.
NO. L-887	Extra Alloy Point



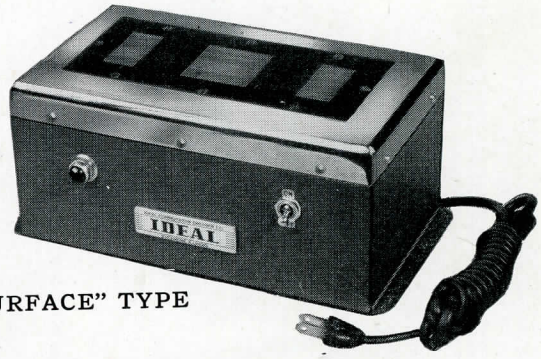
Leads tuck out of way. A modern tool for a modern shop.

DEMAGNETIZERS

Quickly Demagnetizes Work Held in Magnetic Chucks—Tools, Drills, Punches, Dies, etc.

Clinging metal dust, flakes, fine chips, etc., are easily removed from tools and manufactured parts with an IDEAL Demagnetizer. Abrasive particles that can't be wiped away with a rag are easily removed after a single pass across the magnetic poles.

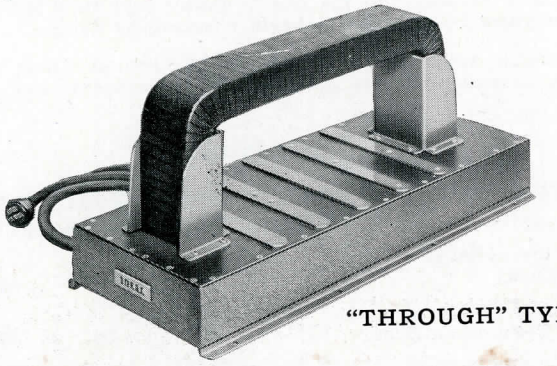
After the tool or part is demagnetized, it can be laid on bench or shelf without again picking up every metal particle in sight.



"SURFACE" TYPE

Cause of Magnetism

Ordinary Magnetic Chucks are the most common cause of magnetism. Any work held in one immediately becomes magnetized and retains some magnetism, even though a reversing switch is used.



"THROUGH" TYPE

Cutting tools, drills, punches, broaches, reamers, etc., often become magnetized from working in a magnetic field—possibly a magnetic chuck, or some other electrical equipment. Even the earth's magnetic field aided by the vibration of the tool as it cuts, can cause a tool to become strongly magnetized.

Demagnetized Tools Stay Sharper

Tools and drills that are not demagnetized often bind, heat and dull long before they normally should. This is caused by the small—sometimes imperceptible—metallic chips and dust that collects on the cutting edge, causing a wedging action that holds back the cutting from rapidly and cleanly leaving the cutting edge. Punches and dies are subject to this same abrasive action which results in shorter runs between grinds and shorter tool life. Demagnetized tools get off to a fresh start—cut faster and more accurately.

Operation

To demagnetize a part—just pass it slowly over the magnetic poles and back again several times until its entire surface has been covered. Then slowly draw the part away from the poles.

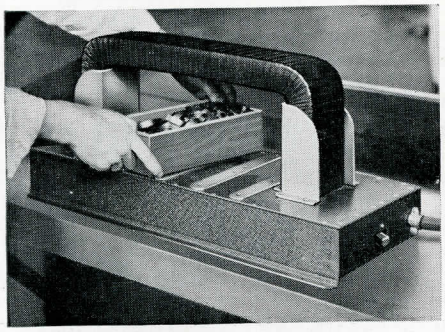
This causes the magnetic effect to become weaker and weaker in each reversal until the part is finally neutralized as it passes entirely out of the magnetic field.

Large parts may also be demagnetized in a similar manner, except that the Demagnetizer which is light in weight and easy to handle, is moved over the heavy, bulky work. When using the "Through" Type Demagnetizer, the work must of course be passed back and forth through the opening and moved away slowly as with any other type Demagnetizer.

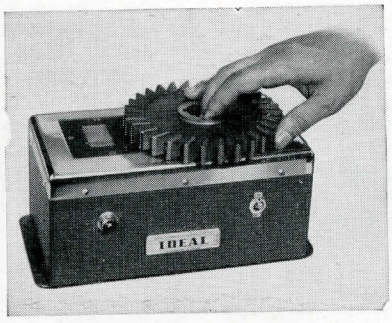
Cat. No.	*Type*	*Weight*	*Current Draw*	*Overall Pole Area*
13-001	Surface	17.5 lb.	5 Amp.	6.35 sq. in
13-005	Surface	40 lb.	15 Amp.	17.6 sq. in.
13-009	Through	90 lb.	45 Amp.	*

*Size of opening 5¾" x 14¾".

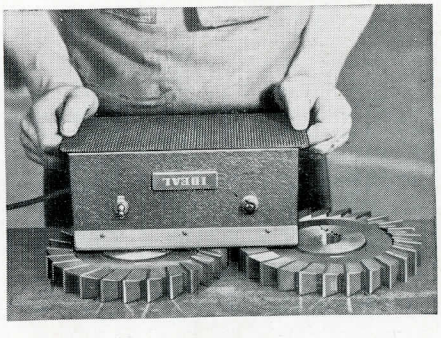
Catalog No. 13-001 and 13-005 are for 115 volt, 50-60 cycle operation. Also available for 230 volt and 25 cycle. Catalog No. 13-009 available for 230 volt, 60 cycle only.



Demagnetizing small parts with "Through Type" Demagnetizer.



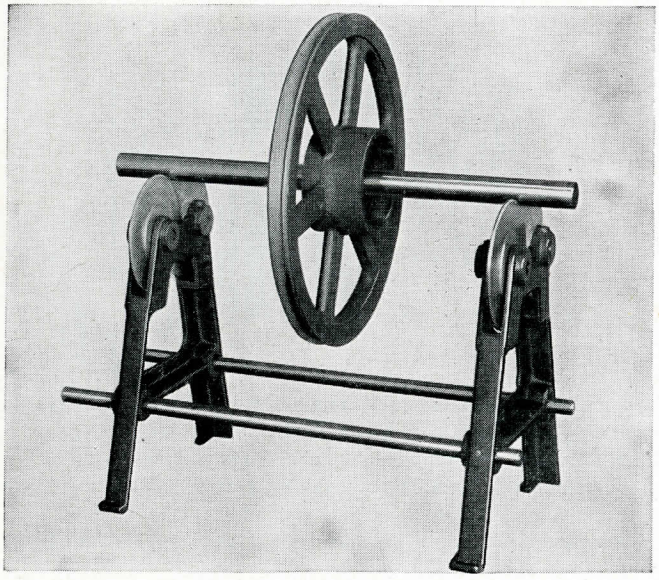
Demagnetizing small objects by moving them across face of "Surface" Type.



Demagnetizing large cutters by moving Demagnetizer over their surface.

See Hints and Tables, Pages 71 to 88

BALANCING WAYS



No Centers Required!

Simplifies static balancing without centering and eliminates the tedious job of setting up knife edges. Speeds up balancing, straightening and truing operation. Regardless of the job—whether it's in production, in general plant maintenance or repair work, IDEAL Balancing Ways will save time.

No Leveling—No Set-Up Necessary

Simply set the Ways on floor or bench and they are ready for use. The work is carried on free turning discs, mounted on precision bearings to permit sensitive balancing. Discs are ground on outside diameters, mounted on ground spindles and balanced with extreme care.

For Static Balancing — Fans, Pulleys, Fly Wheels, Crank Shafts, Grinding Wheels, Armatures, etc.

Especially suitable for supporting armatures while rewinding. *Assures accurate balancing.*

Adjustable . . . Portable

Standards supporting the revolving discs are movable on the two shafts to take different lengths of armatures within the capacity of machine. Longer shafts can be furnished if desired.

If the part to be balanced is in another part of the plant—the Ways can easily be taken apart to make a light, compact package for carrying—take the Ways to the job instead of dragging the heavy, bulky part to a lathe for centering or to some makeshift balancing device.

Made in four sizes from 10" to 60" swing—up to 5,000 lbs. capacity. Check specification table before ordering.

Four Sizes

CATALOG NO.	19-002	19-001	19-003	19-004
Capacity	400 lbs.	1,000 lbs.	1,000 lbs.	5,000 lbs.
Swing (Dia. of work)	10"	20"	42"	60"
Max. Distance between Standards	12"	20"	36"	48"
Shipping weight	13 lbs.	45 lbs.	105 lbs.	225 lbs.

Longer shafts can be furnished when specified at slight additional charge.

"TRU-DRESS" GRINDING WHEEL DRESSER

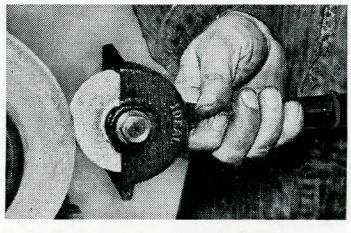
Removes the "Hops" and "Weave" From Uneven Grinders

Made of selected abrasive materials to impart extra hardness, the IDEAL Grinding Wheel Dresser gives a cutting and truing effect almost equal to that of a diamond. Easy to use—no expensive parts to replace!

Regular periodic use keeps grinding wheels clean, sharp and balanced which permits safer and better grinding at all times. Restores dull, glazed wheels to peak efficiency. Can also be used to form simple contours on grinding wheels.

Designed primarily for use on the pedestal type grinder, but works equally well on all sizes of grinding wheels. Large handle makes it convenient to hold and easy to use.

To use, merely engage the "Tru-Dress" with the revolving wheel at a slight angle and carry it across the face or side. By varying the pressure applied against the wheel with the "Tru-Dress," different wheel finishes can be produced to suit the finish required for the job. Overall length, 13¾"; weight, 3⅛ lbs. CUTTING WHEEL 3 in. diam. by 1 in. face, replaceable when necessary.



CATALOG NOS.

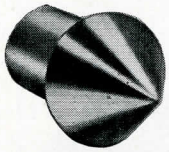
Complete "Tru-Dress" 48-001

Extra Cutting Wheel..... 1214.1

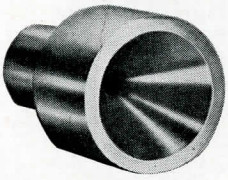
See Hints and Tables, Pages 71 to 88

IDEAL LIVE CENTER

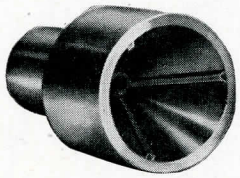
With Interchangeable Center Pieces



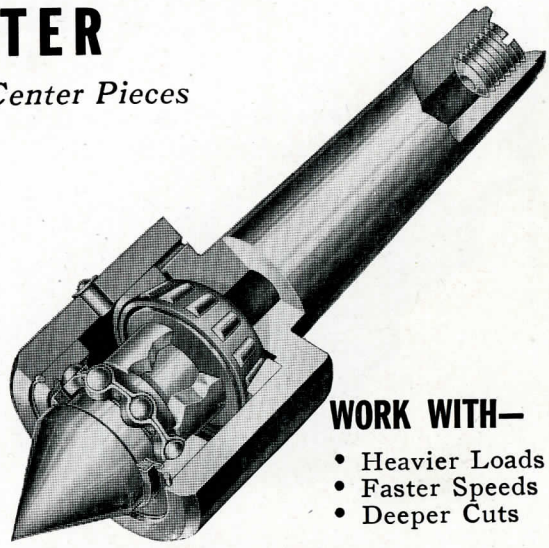
Male Insert furnished as standard.



Plain Female Insert.



Female Insert with three raised lands.



WORK WITH—

- Heavier Loads
- Faster Speeds
- Deeper Cuts

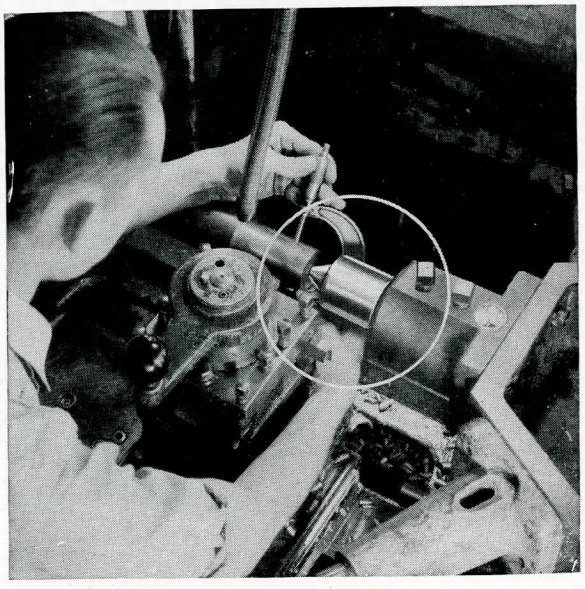
PATENTED—No. 2,118,301

A NEW LOW COST TOOL THAT CUTS PRODUCTION COSTS ON LATHES, SCREW MACHINES, MILLERS, ETC.

Heavy loads, high speeds and deep cuts are not a problem when using an IDEAL Live Center. The Center rotates with work. The radial load is carried by a high precision ball bearing, while thrust load is absorbed by a high precision taper roller bearing. A combination that assures rigidity to rotating insert. Manufactured to highest standards of quality.

Triple Duty—Three Interchangeable Inserts

An exclusive IDEAL Feature! With IDEAL Live Centers, three different Center Pieces or Inserts are available and may be used interchangeably, depending upon the type of work to be held: (1) *Male Insert*—for work already centered (2) *Plain Female Insert*—for uncentered work, i.e., drills, shafts, tubes, etc. (3) *Female Insert With Lands*—for uncentered work having flat, or burred keyway. Inserts are quickly removable, by merely holding the Live Center in arbor press and pressing out the inserts by means of a rod applied through the hole in the shank. *Much set-up time is saved through the use of these Inserts—a further help in cutting production costs.*



A Real Precision Tool

Special bearing arrangement plus precision workmanship—obtainable only in the IDEAL Center, *assures accurate turning,* even after long service. Only high precision type bearings are used. Cutting oil, dirt and chips are kept out by the bearing seal. ALL PARTS ARE HARDENED AND GROUND.

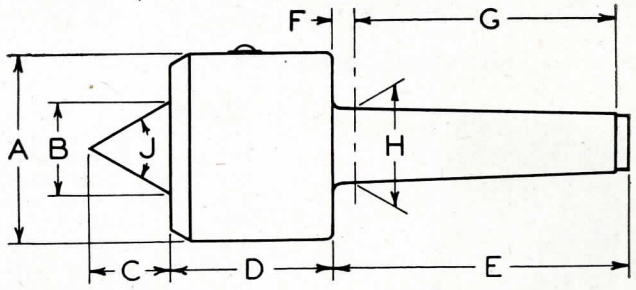
Pipe Inserts for B and C Size Centers

NO. K-993-3 For "B" Size Center. Capacity ½" to 3" pipe
NO. K-1024-1 For "C" Size Center. Capacity ½" to 3" pipe

Capacity of Female Inserts

NO. K-1056-2 (Plain) for "A" Size Center.....⅜" to ¾"
NO. K-1057-2 (Plain) for "B" Size Center.....⅜" to 1"
NO. K-1058-2 (Plain) for "C" Size Center.....⅜" to 1¼"

NO. K-1059-2 (With Lands) for "A" Size Center ⅜" to ¾"
NO. K-1060-2 (With Lands) for "B" Size Center ⅜" to 1"
NO. K-1061-2 (With Lands) for "C" Size Center ⅜" to 1¼"



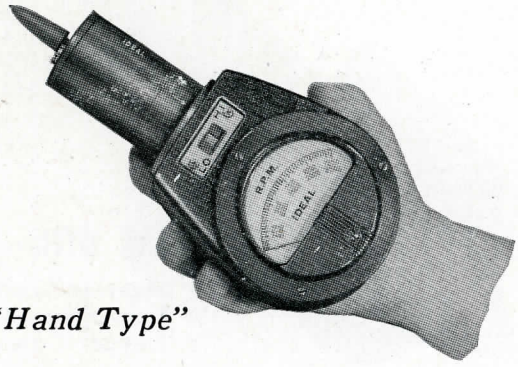
Catalog Number	Size No.	Morse Taper No.	DIMENSIONS A	B	C	D	E	F	G	H	J	Load At 100 RPM Radial	Thrust
47-001	1-MA	1	1 11/16	.850	7/8	1 9/16	2 1/16	.188	2 1/8	.475	60°	250	250
47-002	2-MA	2	1 11/16	.850	7/8	1 9/16	2 1/8	.188	2 1/16	.700	60°	250	250
47-003	3-MA	3	1 11/16	.850	7/8	1 9/16	3 9/16	.250	3 3/16	.938	60°	250	250
47-008	3-MB	3	1 15/16	1.00	1 1/32	2 1/16	3 9/16	.250	3 3/16	.938	60°	400	400
47-009	4-MB	4	1 15/16	1.00	1 1/32	2 1/16	4 7/16	.250	4 1/16	1.231	60°	400	400
47-013	4-MC	4	2 5/16	1.312	1 7/16	2 5/8	4 7/16	.250	4 1/16	1.231	60°	600	600
47-014	5-MC	5	2 5/16	1.312	1 7/16	2 5/8	5 5/8	.313	5 5/16	1.748	60°	600	600
47-026	1½-SC	Straight	2 5/16	1.312	1 7/16	2 5/8	4 9/32	....	...	1.500	60°	600	600
47-027	1¾-SC	Straight	2 5/16	1.312	1 7/16	2 5/8	5 5/16	....	...	1.750	60°	600	600
*47-028	6-MH	6	4 1/4	1.938	2 1/4	2 9/16	7 5/8	.375	7 1/4	2.500	60°	5750	8500

*#6-MD Live Center made to different design. Send for complete details.

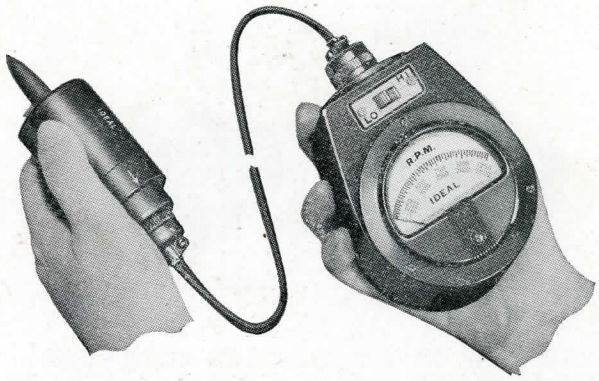
ELECTRIC TACHOMETER

(SELF-ENERGIZED)

Gives Accurate Check on Production Speeds



As "Hand Type"



As "Separable Type"

- *2 Sizes*
- *For Speeds up to 5,000 RPM*
- *Accurate to + or — 1 per cent of Full Scale Deflection*

IDEAL's Self-Energized Electric Tachometer provides a new step in speed measurement for all testing, laboratory and production requirements. Essentially, the IDEAL Tachometer consists of a small generator coupled electrically to an electric meter. Variations in speed of the generator are positively and accurately determined by the meter. Can be operated continuously at any speed.

Electrically and Mechanically Sturdy

The electrical generator consists of a small, permanent "Alnico" magnet rotor. It is mounted on precision sealed ball bearings capable of continuous operation at any speed within limit of the meter. As alternating current is generated within the Tachometer itself, no brushes, commutators or gears are required—thus assuring rugged reliability for all types of service.

Rugged, Reliable Meter

Furnished with strong, artificial case.

The meter or indicating instrument, is a rectifier type including a sturdy D'Arsonval movement. It is capable of withstanding a momentary overload up to 4 times the maximum speed indication without damage. The meter is provided with two scales — "Hi" and "Lo." The "Hi" scale indicates the maximum reading obtainable. (2500 RPM or 5000 RPM), while the "Lo" scale maximum is ½ of the "Hi" scale. The meter movement is mounted on fine jewels, providing close overall accuracy (maximum of plus or minus 1 per cent of full scale deflection). It is suitable for either intermittent or steady service, requires no lubrication, and minimum of attention.

A small switch incorporated in the meter case provides for easy changing from the "Hi" to "Lo" range.

The meter and generator cases are made of metal and plastic, offering a maximum in shock resistance and ability to withstand all normal operating abuse.

Generator Separable From Meter

The generator and the meter are made as distinctly separate elements which are coupled together by a precision made bayonet lock. The units may be used together as a "Hand Type" Tachometer, or for many applications including permanent mounting, the generator and meter may be separated—"Separable Type" and connected only by a 2 conductor electric cord. A 5 ft. cord complete with coupling plug is provided, but a cord up to several hundred feet long (of proper size wire) can be used without introducing an appreciable error in scale reading—not affected by vibration!

A Complete Instrument

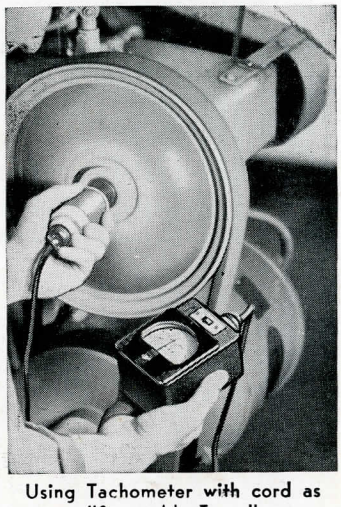
Two rubber tips are provided with every Tachometer so that speeds of any shaft, whether centered or uncentered, can be determined at once. All parts are enclosed in a strong, artificial leather covered, plush lined case.

Size of generator only —1⅝" dia. x 3¾" long, (including ¾" shaft extension), weight 8 oz. *Size of meter*—3"x 4¼" x 2½", weight 20 oz.

Size of complete unit —3" x 7½" x 2½" (including ¾" shaft extension), weight 3 lbs.

CATALOG NO. 50-001
0 to 2500 RPM.

CATALOG NO. 50-002
0 to 5000 RPM.

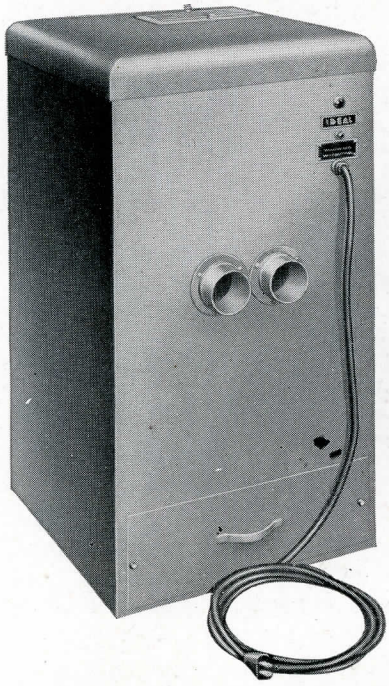


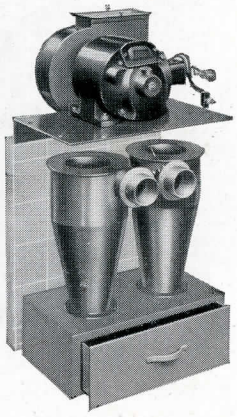
Using Tachometer with cord as "Separable Type."

DUST COLLECTOR

Easily Installed on Any Machine

• *Inexpensive* • *Powerful* • *Twin Cyclone Cleaners*





Metal housing removed to show internal construction. Note how air enters twin cyclone before passing through filter.

Abrasive dust, metal particles, fine chips, flakes and other dirt can all be thoroughly removed with this new IDEAL Dust Collector. Standard attachments simplify installation on grinders, buffers, sanders, polishers, lathes and other machines.

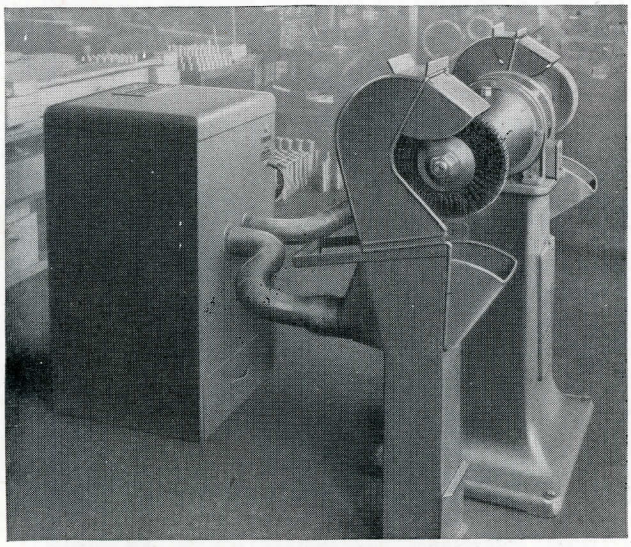
A Completely Enclosed Unit

The IDEAL Dust Collector is compact in size and readily fits behind or beside various types of machines as they stand—relocation of machines, elaborate housings, separate rooms, expensive ducts, etc. are unnecessary.

Cyclones are Supplemented by Filter

REAL Cleaning Power—500 cubic feet per minute is developed through the two inlets by a ¾ HP 3450 r.p.m. motor driving a 7½" diam. x 2" wide squirrel cage blower wheel.

The two 3" diam. inlets can serve either one or two machines.



IDEAL Dust Collector, installed on Buffing Lathe

Dust laden air is drawn through the inlet pipes into twin cyclone separators where it is whirled around at high speed; the dust particles being heavier than air naturally move more slowly and drop down into the dust drawer.

The lighter air passes on through a viscous coated filter where very fine dust is removed. CLEAN AIR is discharged back into the room.

The filter consists of 20 layers of viscous coated filter paper. To restore the filters efficiency after it becomes dirty, it is only necessary to peal off the first two layers.

This can be done five times without affecting its cleaning ability. Under average conditions, a filter lasts approximately a year or more.

Easy to Install

Complete in its attractive metal housing, the IDEAL Dust Collector can be quickly put into operation. A wide selection of standard hose, couplings and nozzles facilitates installation on most machines.

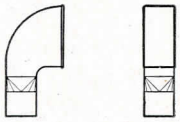
Any one of three sides may be backed up against the wall or machine, as all controls, inlets and dust drawer are located on the fourth side. Plugs into ordinary electrical outlet.

Specifications

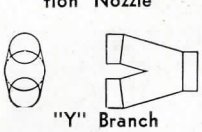
Dimensions: 20" x 20" x 38" high.
Capacity: 250 c.f.m. through each of two inlets.
Inlets: Two 3" dia. inlets located 22" above floor.
Cyclones: Two 8" dia. cyclones of heavy construction.
Dust Drawer: 17" x 9½" x 5½".
Filter: 20" x 25" x 2" renewable pad type.
Blower wheel: 7½" dia. x 2" wide, pressed steel, squirrel cage type.
Motor: ¾ HP, 3450 r.p.m., ball bearing with thermal overload protected (3 phase and D.C. motors do not have thermal overload protection built into motor.)
Weight: 265 pounds (shipping)

CATALOG NO. 55-001 . . . 115 volts, 60 cycle (single phase)
CATALOG NO. 55-003 . . . 230 volts, 60 cycle (single phase)

ATTACHMENTS



Right Angle Suction Nozzle



"Y" Branch

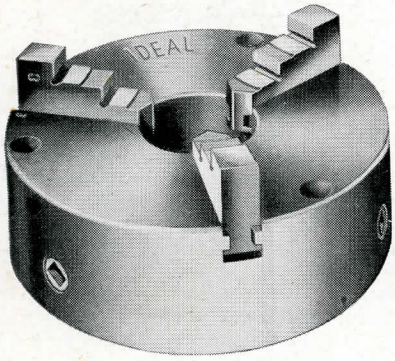
Straight Suction Nozzle

Hose Reducer

CATALOG NO. 1-617-1 3" dia. x3"x6" Right Angle Type Nozzle
CATALOG NO. 1-618-1 4" dia. x4"x8" Right Angle Type Nozzle
CATALOG NO. 1-619-1 3" dia. x3"x6" Straight Type Nozzle
CATALOG NO. 1-620-1 4" dia. x4"x8" Straight Type Nozzle
CATALOG NO. K-1020-2 4" x 3" x 3" "Y" Branch
CATALOG NO. K-1386-1 4"x3" Pipe Reducer
CATALOG NO. 1262.1 3" Hose Clamp
CATALOG NO. 1261.5 3" Rubber Coupl.
CATALOG NO. 1261.1 3"dia.x10'long Rubber Covered Hose
CATALOG NO. 962.5 3" Metal Hose
CATALOG NO. 962.6 4" Metal Hose
CATALOG NO. 1231.2 20"x25"x2" Replacement Filter (Pad Only)
CARALOG NO. 1231.1 Filter Pad Complete with Grid

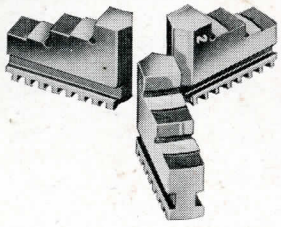
See Hints and Tables, Pages 71 to 88

"UNIVERSAL" CHUCK



3-Jaw

Self-Centering



This is a self-centering type Chuck—all jaws move concentrically by applying a wrench to any one of three (3) Pinions.

The BODY is made of fine grain, high tensile strength steel. Rib construction provides ample resistance to shock load and unusual stress.

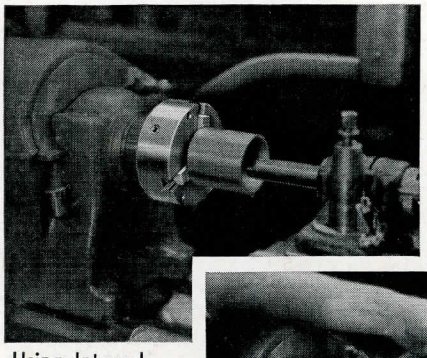
The SCROLL is made from alloy steel. It is of heavy proportions to assure long life and true turning. The Scroll being the "heart" of the Chuck, no expense was spared in providing special tooling to make the thread just as accurate as possible. The thread is milled on a special machine to extremely close tolerances. PINIONS are made of Alloy Steel, hardened for maximum strength.

Two Sets of Jaws

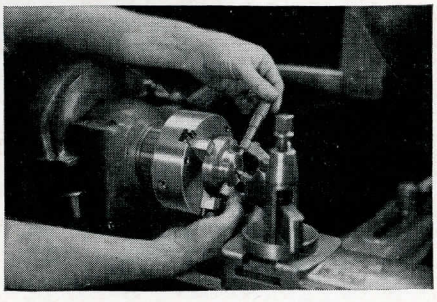
Two sets of JAWS are furnished with each Chuck—(1) For Internal work and (2) for External work. Jaws are Alloy Steel specially treated to impart toughness and strength.

CATALOG NO. 59-001 Includes mounting adapter casting, internal and external jaws, wrench and mounting screws. Shipping weight 13 lbs.

CATALOG NO. 59-003 Body threaded for direct mounting on spindle with 1½"-8 thread. Weight 12 lbs.

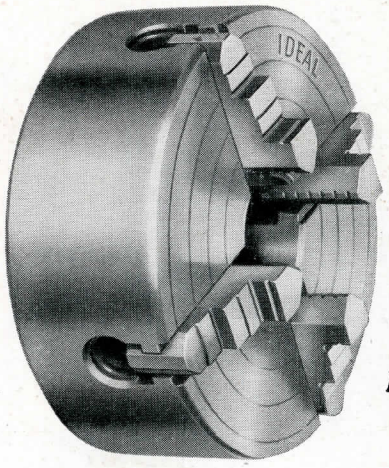


Using Internal Jaws



Using External Jaws

"INDEPENDENT" CHUCK



4-Jaws

An Inexpensive Chuck—Precision Made For Dependable Service

A medium duty Chuck designed to give long dependable service. All parts are made to extremely close tolerances, permitting accurate adjustment. Simplifies set up and assures true turning.

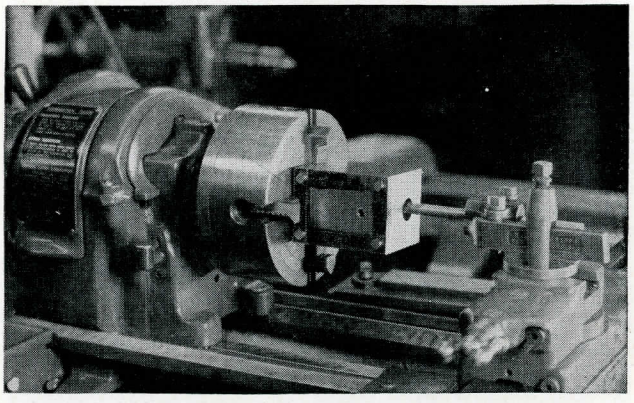
The BODY is made of one piece, fine grain, high tensile strength semi-steel. Ribbed type construction provides ample resistance to shock loads and unusual stress. The Face is accurately ground and polished. Graduation lines simplify the centering of work regardless of shape.

JAW ADJUSTING SCREWS are made from tough alloy steel. Threads are oversize—square cut and hardened to give maximum strength. The rigid specifications to which these screws are made explain why the IDEAL Chuck is easy to adjust—no excessive play.

JAWS are made of steel, accurately ground and hardened. Each Jaw has raised steps with wide gripping surfaces. Jaws are reversible for gripping either externally or internally.

CATALOG NO. 59-002 Includes adapter casting, wrench and mounting screws. Shipping weight 14 lbs.

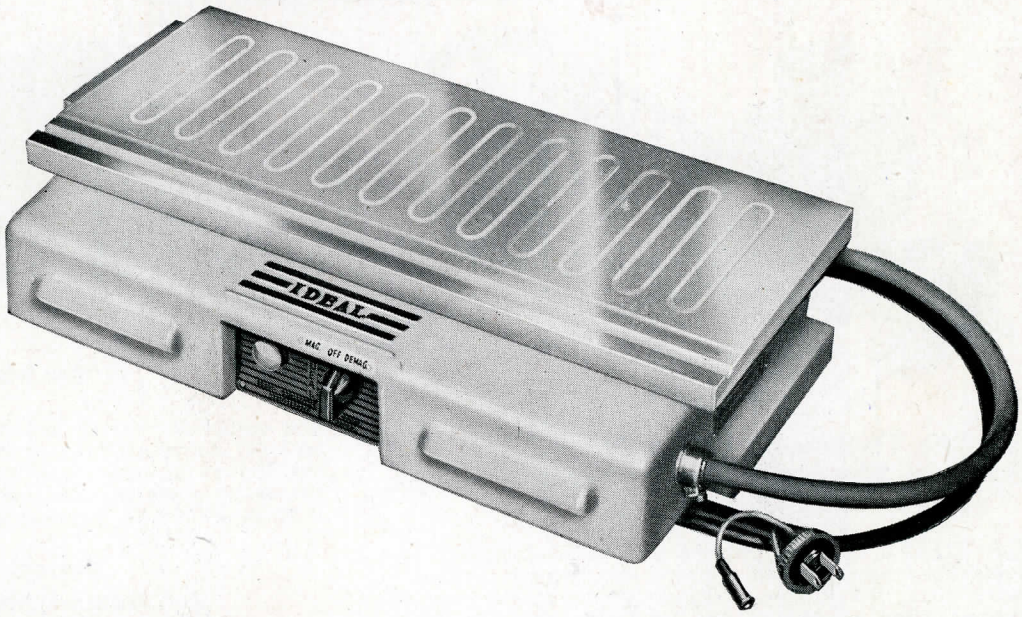
CATALOG NO. 59-004 Body threaded for direct mounting on spindle with 1½"-8 thread. Weight 13 lbs.



Using "Independent" Chuck to hold drill jig while boring off-center hole.

"AC" MAGNETIC CHUCK
AND DEMAGNETIZER

Operates From Any Alternating Current Outlet



A 3-in 1 Combination

(1) Magnetic Chuck
(2) Demagnetizer
(3) A.C. Rectifier

No clamps, vises or special holding devices are needed with the IDEAL "A C" Magnetic Chuck. Any work placed on the Chuck is instantly and rigidly held in position.

Saves time on surface grinders, planers and milling machines, shapers and other similar operations; holds work for polishing, scraping, etc. The top, bottom, back edge and working end of the Chuck are machined to assure extreme accuracy. Speeds production—reduces cost.

Operates From Alternating Current

An AC rectifier is built right into the IDEAL Magnetic Chuck so it operates from any ordinary alterating current outlet. Eliminates the need for AC-DC motor generator set, auxiliary rectifiers or special DC line connections as required with other makes of magnetic chucks, yet, the IDEAL costs no more. Available for both 115 and 230 volt operation.

The IDEAL "AC" Magnetic Chuck is designed with cores and coils arranged in the familiar horseshoe type magnet design which develops maximum magnetic pull. The holding power is further increased by a winding on each pole and through the use of carbon steel poles of high magnetic permeability. Magnetic flux is uniform over the entire surface. All parts are carefully insulated and protected.

Demagnetizes Work

Unlike ordinary magnetic chucks, the IDEAL does not require a separate demagnetizer. After the work is finished, simply turn the switch to "Demag" and pull the work across the top of and away from the Chuck. This leaves it free of *magnetism.*

Other Features

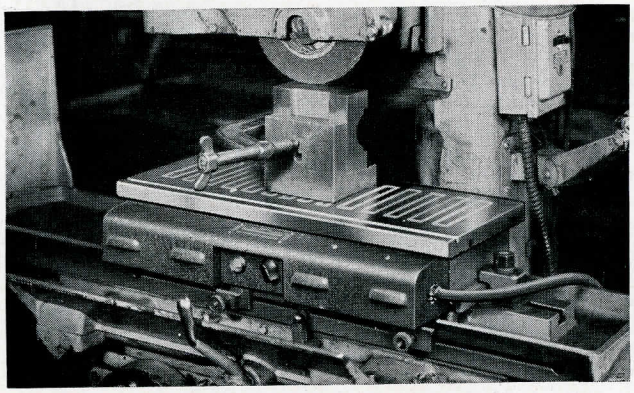
To further aid in speeding production, a pilot light glows whenever the switch is "On", either for "Mag" or "Demag."

CAPACITY—when used with the end stop to take part of the thrust, the IDEAL Magnetic Chuck will hold a 1"x2"x6" bar of steel while milling .050" from the 2" wide surface, at a speed of 1" per minute.

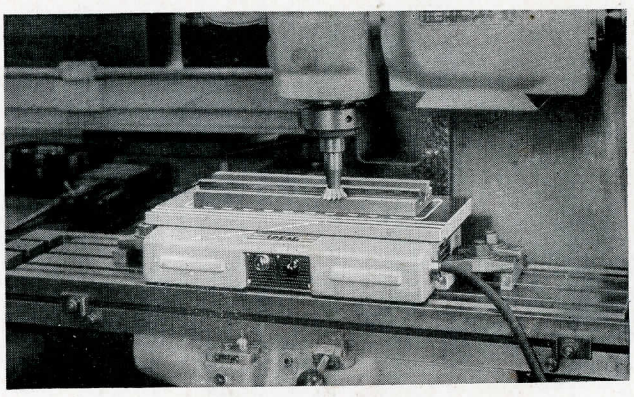
Working surface, 7¾"x18"; magnetic surface, 4½"x 15½"; overall dimensions, 3¾"x18"x9¾".

Rating: 65 watts as Magnetic Chuck, 220 watts as Demagnetizer. Has 5' three conductor safety type cord and plug. Weight 91 lbs.

NO. 51-001.....For 115 volt, 25-60 cycle operation
NO. 51-002.....For 230 volt, 50-60 cycle operation



Using IDEAL Magnetic Chuck with Surface Grinder—saves time—speeds production.

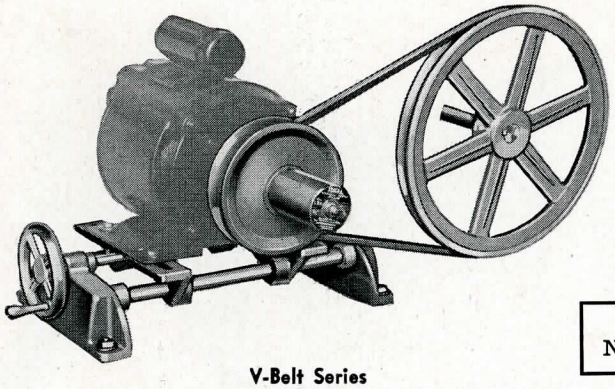


With Universal Milling Machine. Eliminated need for clamps or other awkward holding devices.

See Hints and Tables, Pages 71 to 88

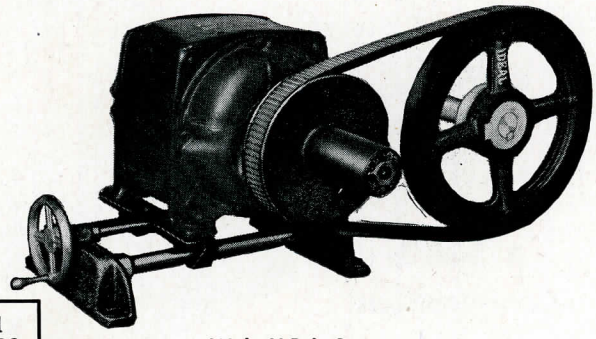
VARIABLE SPEED PULLEY

3 to 1 Maximum Speed Ratio



V-Belt Series

Patented
No. 2313436



Wide V-Belt Series

For the Thousands of Machines That Will Operate More Efficiently With Variable Speed Control

The IDEAL Variable Speed Pulley is designed for use with constant speed motors. By merely turning a hand wheel the driven machine can be speeded up or slowed down as desired and instantly corrected for—Changes in production schedules—Speed ability of different operators—Variation in size of parts or stock—Variation in temperature or humidity—Variation in size or density of materials, etc.

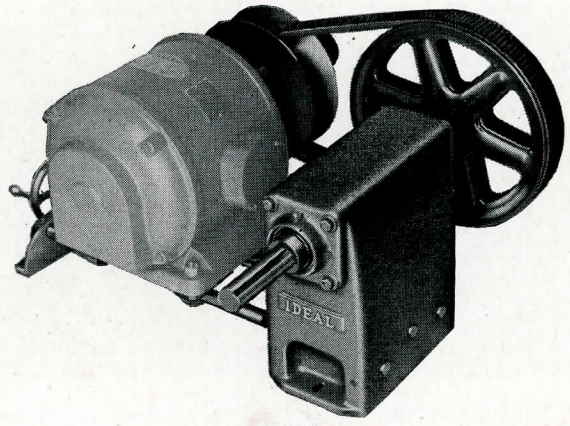
The benefits of such close finger-tip control are directly reflected in the product itself—an improved product manufactured at a lower cost.

Features

- Easy to install
- Curved Pulley Faces
- Both halves of Pulley move
- Compact — light weight — balanced
- Belt always runs in alignment
- Minimum overhang to belt center line
- Positive lubrication
- Up to 3 to 1 speed ratio

Easy To Install

The IDEAL Variable Speed Pulley is available in eight (8) sizes ranging from fractional up to 8 H.P. and with speed ranges up to 3 to 1. Speeds are infinitely variable while running. Installation is as easy as an ordinary V-Belt drive, yet accurate and infinitely variable speed adjustment is permitted over a wide range.



Countershaft Unit

The complete control includes (1) Variable Speed Pulley; (2) Adjustable Motor Base; (3) Wide V-Belt; and (4) Driven Sheave. The Pulley is mounted directly to the motor shaft (in place of V-sheave) while the motor is mounted on the Adjustable Motor Base.

V-Belt Series

(For Fractional Horsepower Drives)

The V-Belt Series Pulley is especially designed for all kinds of light machinery. It requires only standard V-Belts and gives dependable low cost speed control. Sizes up to ¾ HP.

The Pulley faces are curved so that the belt faces have full contact at all pitch diameters. This "exclusive" feature assures full transmission of driving power and prolongs belt life. As the speed is changed, both halves of the Pulley move so that the belt is always in alignment. Careful balancing eliminates noise or vibration.

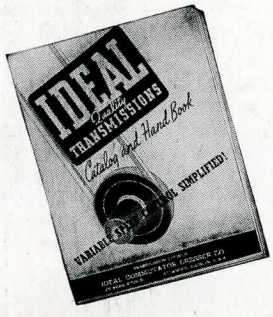
Wide V-Belt Series

(For Drives Up To 8 HP)

Five sizes of Variable Speed Pulleys are included in this series and are available as complete drives with Wide V-Belts and Wide V-Belt Driven Sheaves.

The overall efficiency of the IDEAL Wide V-Belt Drive is approximately 90%. By driving to a Wide V-Belt Sheave designed for the job instead of to an ordinary flat belt pulley this efficiency is easily obtained.

Incorporated in the design are many new and "exclusive" features, all of which combine to give accurate finger tip control of adjustable machine speeds.



Ask for your copy of complete Transmission Catalog and Handbook—FREE.

Countershaft Unit

(For Slow Speed or Speed-Up Drives)

The IDEAL Variable Speed Pulley Countershaft Unit includes a standard IDEAL Wide V-Belt Drive together with a Countershaft Base assembly.

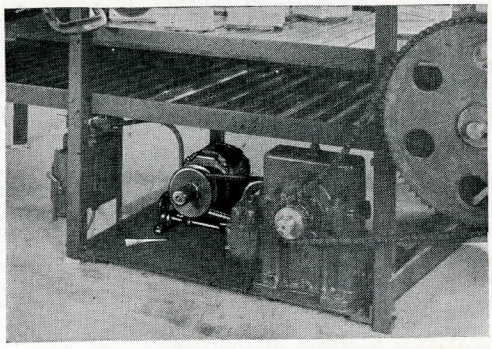
It effects a multiple change in speed—from IDEAL Motor Pulley to Countershaft and from Countershaft to Driven Sheave. Ideally suited for slow speed drives, for application where the size of driven sheave for direct driving is prohibitive, or where space limitations fix the maximum size of the sheave. Drive from either side. Compact—flexible design.

VARIABLE SPEED PULLEY

For Old or New Equipment

Old (fixed speed) machines formerly limited to a few production operations can readily be modernized by installing the IDEAL Variable Speed Pulley. Builders of NEW Machines find that the IDEAL Pulley gives their product an additional selling advantage for it helps to increase machine performance, thus giving more customer satisfaction.

Designed by experienced Transmission Engineers, the IDEAL Variable Speed Pulley is extremely compact and light weight with minimum overhang to the belt center line. The complete Pulley is balanced, assuring noiseless variable speed control and long satisfactory service.

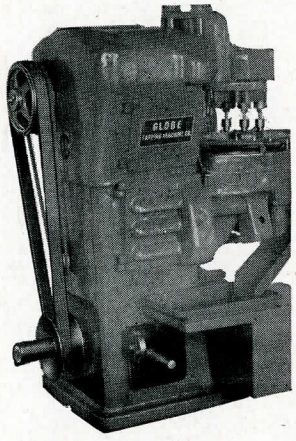


IDEAL Variable Speed Pulley with right angle speed reducer. Controls speed of conveyor in large printing plant.

Recommendations

Selection of the proper size IDEAL Variable Speed Drive depends upon (1) horsepower requirements; (2) shaft center distance; and (3) maximum and minimum driven speeds desired.

For the average, steady, uniform running drive, the IDEAL Pulley should have the same rated capacity as the motor. However, where the drive is subject to frequent starting and stopping, load shock, and other similar conditions, correction factors must be taken into consideration to assure a smooth running drive.



IDEAL Wide V-Belt Pulley included in design of Tapping Machine. Permits speed control between 15 and 45 cycles per minute.

Experienced IDEAL Transmission Engineers are at your service — don't hesitate to ask for recommendations on any particular application.

Formulas

The following formulas are very helpful in the selection of average Variable Speed Drives.

P.D. of Driven Sheave =

$$\frac{\text{Max. P.D. of IDEAL Pulley} \times \text{Motor RPM.}}{\text{Maximum Driven Speed (R.P.M.)}}$$

Approximate Belt Length = $2x + 1.65\ (y+z)$

Where x = shaft center distance (max. speed position)
Where y = P.D. of driven sheave
Where z = Maximum P.D. of IDEAL Pulley

NOTE: Pitch diameter of Wide V-Belt running on flat pulley = diameter of Pulley plus belt thickness.

BASE SPECIFICATIONS

Size	Length	Width	Height Less Wheel	Shipping Wt. Lbs.
135	13 5/8"	7"	2 1/2"	14
145-60	16 1/2"	8 3/4"	3"	17
301	18 7/8"	10"	3 1/2"	19
302-3	20 1/8"	10"	3 1/2"	22
305-8	28 1/4"	14"	4 3/4"	45

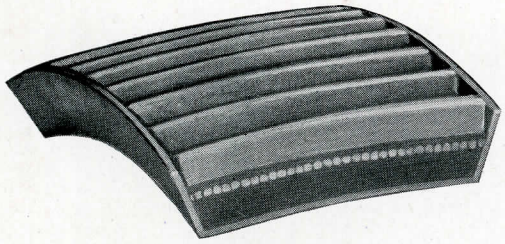
PULLEY DIMENSIONS AND RATINGS

PULLEY SIZE	135	135	145	160	301	302	303	305	308
Max. H.P. with 1750 R.P.M. Motor	1/4	1/4	1/2	3/4	1	2	3	5	8
Max. H.P. with 1150 R.P.M. Motor	1/8	1/8	1/3	1/2	2/3	1 1/3	2	3 1/3	5 1/3
Speed Ratio—Max. to Min.	2.25 to 1	2 to 1	2 to 1	2.75 to 1	3 to 1	3 to 1	3 to 1	3 to 1	3 to 1
Max. Pitch Diameter	3.25	3.25	4.25	5.75	7.06	8.53	9.53	11.31	12.31
Min. Pitch Diameter	1.44	1.62	2.09	2.09	2.35	2.84	3.17	3.76	4.10
Standard Bore	1/2 or 5/8	1/2 or 5/8	1/2, 5/8 or 3/4	5/8 or 3/4	3/4 or 1	3/4, 1 or 1 1/8	1 or 1 1/8	1, 1 1/8 or 1 1/4	1 1/4 or 1 5/8
Length of Bore	3 1/16	3 1/16	2 1/4	2 3/4	2 3/4	3	3 1/2	3 3/4	3 3/4
Size Belt	3/8	A	A	A	No. 12	No. 18	No. 18	No. 27	No. 27
Adjustable Base Required	135	135	145-60	145-60	301	302-3	302-3	305-8	305-8
Shipping Weight in Lbs.	2 1/2	2 1/2	8	9	13	19	20	34	41

*Keyways: 1/2" bore—none; 5/8" and 3/4" bore—3/16"x3/32"; 1" to 1 1/4" bore—1/4"x1/8": 1 5/8" bore—3/8"x3/16".

See Hints and Tables, Pages 71 to 88

WIDE V-BELTS



For use with IDEAL Wide V-Belt Drives and Countershaft units. Has every feature of the standard V-Belt, plus the ability to transmit greater horsepower per belt. The IDEAL Wide V-Belt is properly built (proved by careful tests and use) to give long service and transmit full rated horsepower. Maximum recommended belt speed is 5650 feet per minute.

Experienced IDEAL Engineers are at Your Service. Your Transmission Problems are WELCOME.

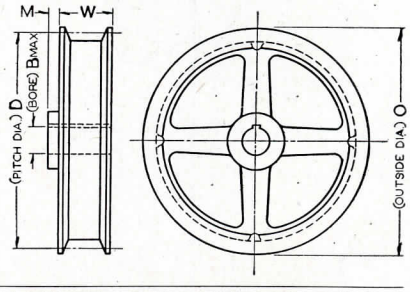
SIZE 12 BELT (FOR NO. 301 PULLEY)				SIZE 18 BELT (FOR NOS. 302 AND 303 PULLEY)				SIZE 27 BELT (FOR NOS. 305 AND 308 PULLEY)			
No.	Pitch Length	Ship. Wt. (lbs.)	Top Width	No.	Pitch Length	Ship. Wt. (lbs.)	Top Width	No.	Pitch Length	Ship. Wt. (lbs.)	Top Width
34- 360-12	36″	3	13/16″	34- 480-18	48″	3½	1 13/16″	34- 600-27	60″	8	2¾″
34- 420-12	42″	3	13/16″	34- 540-18	54″	3½	1 13/16″	34- 660-27	66″	8	2¾″
34- 480-12	48″	3	13/16″	34- 600-18	60″	4	1 13/16″	*34- 720-27	72″	8½	2¾″
34- 540-12	54″	3	13/16″	34- 660-18	66″	4	1 13/16″	34- 780-27	78″	9	2¾″
*34- 600-02	60″	3	13/16″	*34- 720-18	72″	4	1 13/16″	34- 840-27	84″	9½	2¾″
34- 660-12	66″	3	13/16″	34- 780-18	78″	4½	1 13/16″	34- 900-27	90″	10	2¾″
34- 750-12	75″	3½	13/16″	34- 849-18	85″	4½	1 13/16″	34- 960-27	96″	10	2¾″
34- 840-12	84″	3½	13/16″	34- 900-18	90″	5	1 13/16″	34-1020-27	102″	11	2¾″
34- 960-12	96″	4	13/16″	34- 960-18	96″	5	1 13/16″	34-1140-27	114″	12	2¾″
34-1020-12	102″	4	13/16″	34-1000-18	100″	5	1 13/16″	34-1310-27	131″	14	2¾″
34-1140-12	114″	4	13/16″	34-1140-18	114″	6	1 13/16″	34-1400-27	140″	16	2¾″
34-1270-12	127″	4½	13/16″	34-1270-18	127″	7	1 13/16″				
34-1400-12	140″	5	13/16″	34-1400-18	140″	8	1 13/16″				

*Standard Belt (supplied with Pulley unless otherwise specified.)

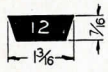
WIDE V-BELT SHEAVES

IDEAL Wide V-Belt Sheaves are made of close grained gray iron, cast to provide ample strength without excessive weight. Accurately machined and balanced for true running operation—will not spring or vibrate. The combination of the IDEAL Wide V-Belt and the IDEAL Wide V-Belt Sheave assures maximum efficiency of power transmission at all times with long belt life. The V-Belt sides firmly grip the sides of the Sheaves so that the belt cannot slip.

MADE WITH INTERCHANGEABLE BUSHINGS TO PERMIT THEIR USE WITH DIFFERENT DIAMETER SHAFTS. ALL BUSHINGS HAVE STANDARD S.A.E. KEYWAYS. EACH IDEAL WIDE V-BELT SHEAVE INCLUDES ONE BUSHING.



For Size 12 Belt (No. 301 Pulley)

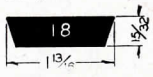


O	D	B	W	M	Shipping Wt. (lbs.)
7	6.6	1⅝	1 7/16	½	10
8	7.6	1⅝	1 7/16	½	12½
9	8.6	2 7/16	1 7/16	9/16	13½
10	9.6	2 7/16	1 7/16	9/16	15½
12	11.6	2 7/16	1 7/16	9/16	17½
14	13.6	2 7/16	1 7/16	9/16	19½
16	15.6	2 7/16	1 7/16	9/16	22

Stock Bushings

Size 91 (For 7″ and 8″ Dia.)—¾, ⅞, 15/16, 1, 1⅛, 1 3/16, 1¼, 1 7/16, 1½.
Size 92—For 9″ to 16″ diameters.

For Size 18 Belt (Nos. 302 and 303 Pulley)

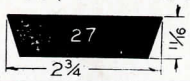


O	D	B	W	M	Shipping Wt. (lbs.)
8	7.5	2 7/16	2 1/16	¼	15
9	8.5	2 7/16	2 1/16	¼	15½
10	9.5	2 7/16	2 1/16	¼	18
12	11.5	2 7/16	2 1/16	¼	20½
14	13.5	2 7/16	2 1/16	¼	23
16	15.5	2 7/16	2 1/16	¼	25

Stock Bushings

SIZE 92—¾, ⅞, 15/16, 1, 1⅛, 1 3/16, 1¼, 1⅜, 1 7/16, 1½, 1⅝, 1 11/16, 1¾, 1⅞, 1 15/16, 2, 2 3/16, 2 7/16.

For Size 27 Belt (Nos. 305 and 308 Pulley)



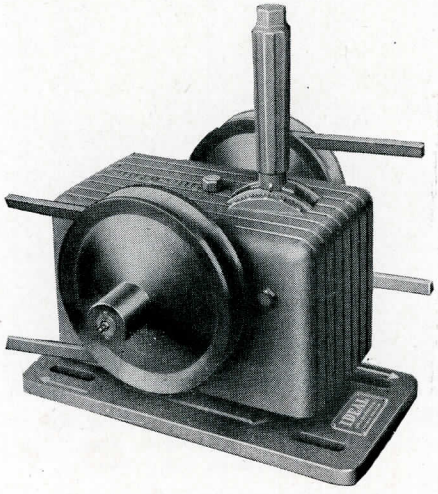
O	D	B	W	M	Shipping Wt. (lbs.)
12	11.3	2 7/16	3	7/16	26½
14	13.3	2 7/16	3	7/16	30½
16	15.3	2 7/16	3	7/16	33

Stock Bushings

SIZE 93—¾, 1, 1⅛, 1 3/16, 1¼, 1⅜, 1 7/16, 1½, 1⅝, 1 11/16, 1¾, 1⅞, 1 15/16, 2, 2 3/16, 2⅜, 2 7/16.

"SELECT-O-SPEED" TRANSMISSION

Uses Standard V-Belts



IDEAL Lever Control — available on all sizes.

Sizes Up To 7½ HP

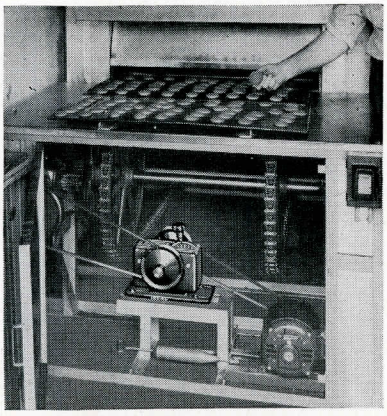
The IDEAL "Select-O-Speed" Transmission is recommended for application on NEW or OLD machines, wherever a wide range of driven speeds is desired. It is easily installed in the line of drive and permits instant, accurate control of speed.

Thousands of IDEAL "Select-O-Speed" Transmissions are today furnishing machine operators in many industries with *low* cost speed control of various types of production machines. With the touch of a finger an almost infinite number of speed variations can be obtained —instantly—while the machine is in operation.

Easy To Install

No expensive alterations are necessary—the "Select-O-Speed" comes completely assembled, ready to set up in line of present drive—between motor and driven sheave. As easy to install as a V-Belt Drive. Can be mounted in any position, right-side-up or upside-down.

Changes in driven speeds are made by shifting the "Select-O-Speed" control lever. This causes a momentary variation in tension between the driving and driven belts which changes the sheave pitch diameter. The control lever moves through a predetermined arc and can be locked in any selected speed position by a partial turn of the control knob.



IDEAL "Select-O-Speed" Controls baking speed on 48-ft. traveling oven.

As the "Select-O-Speed" Transmission is shifted to change speed, the shaft assembly moves with the control lever in a diagonal direction. This angular shifting maintains fixed belt center lines—constant alignment. The Transmission is enclosed for safety and for protection against dirt and foreign matter. Ball bearings used throughout. Vibration and noise, found in most transmissions, are eliminated by careful machining, matching and balancing of sheaves. The sheave fingers are carefully rounded to give maximum belt life. Requires lubrication at only three points—the bearing housing and the ends of the shaft.

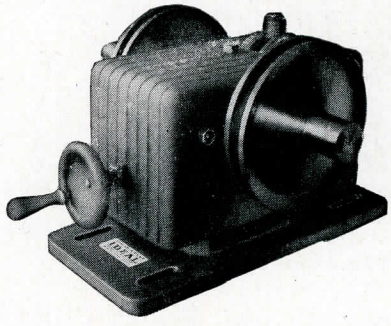
Operating on the adjustable sheave principle, there is a minimum of wearing parts—no expensive replacements. Easily adaptable to individual installation requirements by a selection of controls—lever or hand wheel control.

Types Of Control

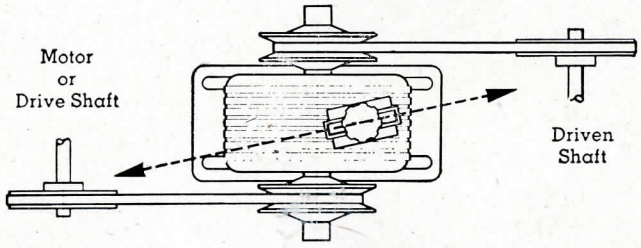
LEVER CONTROL—furnished as standard on all sizes of IDEAL "Select-O-Speed" Transmissions. The lever is readily movable from one position to another and can be locked in any selected speed position by a partial turn of the control knob.

HAND WHEEL CONTROL—The Hand Wheel is recommended for installations on which finer speed adjustments and only slight changes in R.P.M. are required. A partial turn of the wheel changes the machine speed only a few revolutions per minute.

This type of control is also selected by many Machine Users who require REMOTE CONTROL. The hand wheel is easily replaced with a set of small bevel gears, and shaft extension or extensions with universal joints so that the control can be taken to any convenient point.



IDEAL Hand Wheel Control—sizes 9 and 12. Also available for sizes 3½, 4½ and 6.



RIGHT HAND DRIVE—most common installation. If it is necessary that line of drive be to opposite corners, then a LEFT HAND "Select-O-Speed" is required (for left hand drive).

"SELECT-O-SPEED" TRANSMISSION

Use These Formulas To Figure Drives

TO DETERMINE PITCH DIAMETER OF DRIVE AND DRIVEN SHEAVES:

$$\text{P.D. of Driven Sheave} = \frac{\text{P.D. of Drive Sheave} \times \text{Motor R.P.M.} \times \text{Speed Increase Ratio (table)}}{\text{Maximum R.P.M. Desired}}$$

Example—Ordinary Drive:

If motor is 1 H.P., 1750 R.P.M.

Driven speeds desired = 2000 max. to 400 min.

From table (below) choose size 6-B "S-O-S." Speed Ratio 5 to 1.

$$\text{P.D. of Driven Sheave} = \frac{\text{P.D. of Drive Sheave} \times \text{Motor R.P.M.} \times \text{Speed Increase Ratio}}{\text{Maximum R.P.M. Desired.}}$$

$$\text{P.D. of Driven Sheave} = \frac{4 \times 1750 \times 2.24}{2000} = 7.8''$$

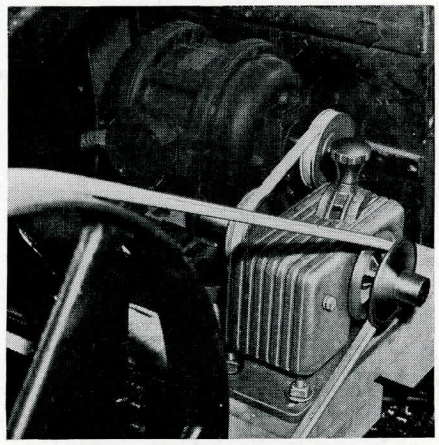
TO DETERMINE BELT LENGTH:

$$\text{Belt length} = 2x + 1.57\,(y + z) + \frac{(y - z)^2}{4x}$$

where x = Center distance to motor, or to driven shaft

where y = Pitch Diameter of the drive or driven sheaves

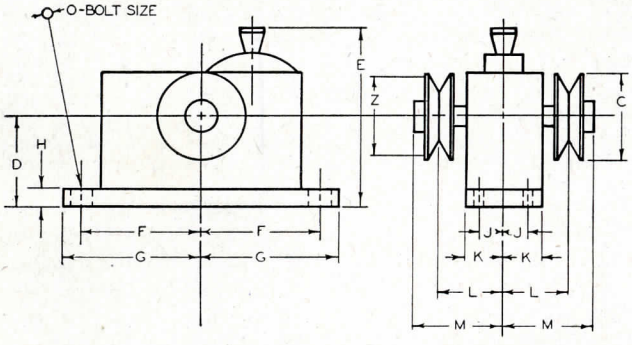
where z = Average Pitch Diameter of transmission sheave (table)



"Select-O-Speed" Transmission brings easy, accurate, speed control to printing press. Drives direct to large flat pulley.

Driven belt speed should not be over 5,000 feet per minute with "S-O-S" in high speed. As a check use formula:

$$\text{Ft. per min.} = \frac{\text{R.P.M.} \times 3.14 \times \text{P.D.}}{12}$$



Size	C	D	E	F	G	H	J	K	L	Max. M	O	Z	
3½	3½	3⅝	7 11/16	3⅜	4⅝	½	1¼	1 13/16	2½	4⅝	⅜	No. 1 2⅜	A 2⅝
4½	4½	5⅜	10⅜	4⅝	6¼	½	2	2⅞	3⅝	5⅝	½	A 3 1/16	B 3⅝
6	6	5⅜	10⅜	4⅝	6¼	½	2	2⅞	4⅛	6⅝	½	A 3¾	B 4
9	9	8	18½	7 1/16	9⅝	¾	3	4⅜	5⅞	13¾	⅝	B 5⅜	C 6⅝
12	12	10	23	9 1/16	12 13/16	1	3½	5 13/16	7⅛	15½	¾	C 7⅝	D 9⅛

RECOMMENDED H.P. RATING AND SPEED RATIO
ALSO RECOMMENDED PITCH DIAMETER FOR DRIVE SHEAVE

Size "S-O-S"	Size* Belt	Max. H.P.	SPEED INCREASE RATIO Above & Below Aver. R.P.M.	Speed Ratio	(Z) Aver. "S-O-S" Pitch Dia.	**RECOMMENDED DRIVE SHEAVE DIAMETERS		
						1750 R.P.M.	1150 R.P.M.	875 R.P.M.
3½-1	(⅜") FHP	⅛	2.24	5:1	2⅜"	3"	4.6"	6"
3½-A	A	⅓	1.58	2½:1	2⅝"	4"	6"	8"
4½-A	A	½	2.24	5:1	3 1/16"	4"	6"	8"
4½-B	B	1	1.58	2½:1	3⅝"	5.6"	8.6"	11.2"
6-A	A	½	3.16	10:1	3¾"	3.6"	5.4"	7.2"
6-B	B	1	2.24	5:1	4"	4"	6"	8"
9-B	B	1½	2.74	7½:1	5⅜"	4"	6"	8"
9-C	C	3	1.73	3:1	6⅝"	6"	9"	12"
12-C	C	5	2.24	5:1	7⅝"	5"	7.5"	10"
12-D	D	7½	1.58	2½:1	9⅛"	—	9"	12"

*Standard V-belts of any recognized make are satisfactory. To insure maximum belt life the recommended normal H.P. rating should be very closely followed when making "Select-O-Speed" applications. These ratings are conservative according to those given by belt manufacturers.

**For Slower Motor Speeds than shown, increase the Drive Sheave Pitch Diameter in the same proportion as reduction in drive speed, if Ratings are to be maintained.

Bridging to Eliminate Flat Spots

For eliminating flats on Commutators and Rings, the IDEAL Resurfacer should be not less than three times the width of the longest flat. In this way the stone will bridge over this flat and eliminate it. Ideals can be shaped to any diameter desired.

Improvised Stone Rest for Deep Flats and High Bars

The mounting of a board upon the brush boxes for a rest, is effective in eliminating flats and high bars. The IDEAL Resurfacer must be held in a fixed position, grinding only the high portions until flats are removed. After the flat has been removed, then the Resurfacer should be moved sideways. This method will give surprising results.

Resurface on Commutator Side with Downward Direction

Whenever possible, use the IDEAL on that side of the Commutator which has the downward direction, with rotation toward the user. This throws the dust to the floor. When grinding on the down side it is possible at times to rest the IDEAL Resurfacer on the brush boxes and arm. When grinding on the downside on the machine, where the brush boxes and the arms form an acute angle to the commutator, keep the Ideal well up against the toes of the upper boxes.

Level Surface on a Tool Type Resurfacer Job

When using Precision Commutator Grinder on a short commutator, feed the tool in at the inner and outer ends only, thereby reducing possible irregularity of feeding. In case a quick or high polish is desired, we suggest that a piece of canvas be placed in under the Resurfacer used to grind the Commutator, then apply great pressure.

Ridge Removal on Eccentric Commutator

For speedy results on eccentric or flatted commutators, use proper size hand type IDEAL Resurfacer of a cutting grade. Continually moving from side to side, remove all ridges—disregarding the eccentricity. Then mount the Precision Commutator Grinder with IDEAL Tool Type Resurfacers of cutting grade, and grind the commutator true with a light pressure. Then remove the Precision Commutator Grinder and finish with hand type IDEAL Resurfacer of the Finish Grade. Use the hand type Resurfacer thereafter as occasio narises to prevent recurrence of the eccentricities.

The cutting speed of the Resurfacer varies in accordance with the face presented; the larger the cutting face the faster the job.

Radial Commutator Resurfacing

For Radial Commutators on single phase motors, use IDEAL Tool-Type Resurfacer or IDEAL "2 in 1" Resurfacer, by hand, wearing off at a slight angle with rotation.

Tapering Tendency of Stone

The human hand does not exert pressure evenly and there is the tendency that a Resurfacer will wear more on one side than on the other. This may be remedied by alternating the hands; first using the right, then the left. Perhaps better, reverse the Resurfacer from time to time. Reversing from time to time also tends to sharpen the edge that approaches the risers.

Your Auto Generator

A small unmounted IDEAL Resurfacer of the Finish Grade is excellent for your automobile generator or starter commutator. Size 5/8" x 3/8" x 6" is quite popular. Clean rigging well after resurfacing.

Your Household or Office Fans and Vacuum Cleaners

A pencil of IDEAL Resurfacer material is excellent for touching up the small commutators on household appliances, office fans and vacuum cleaners. A good size is 5/8" x 3/8" x 6" Finish Grade.

Tapering Tendency of Commutator

Because the riser prevents the stone from being moved further in, there is a tendency to cut less copper at the riser end, causing a tapering commutator with large diameter at riser end. Therefore be sure to cut sufficient copper at riser end.

Burnishing Finish on Commutators

The final polish on a commutator is a subject of considerable discussion. Some engineers require a mirror surface. Others require that the brushes do the polishing.

The IDEAL "Finish" Grade Resurfacer leaves a fine velvet surface; not burnish, as the brushes ride on the surface they automatically seat themselves perfectly and at the same time, burnish the commutator.

For immediate Burnishing, the recent Development of the new Polish Grade IDEAL Resurfacer has eliminated a great deal of effort. The new IDEAL Polish Resurfacer does not contain an abrasive grain but is composed of a grain especially adapted for Polishing. This Polish grade contains no sulphur for darkening the Commutators.

Another method of obtaining a very high polish after a Finishing Grade Resurfacer has been used, is to take a heavy piece of canvas, place it over the face of the Resurfacer and use great pressure. Also, a piece of hard sapless wood arced exactly to the commutator surface may be applied with great pressure.

Dust Removal

A vacuum attachment such as furnished with the IDEAL Blower and Suction Devices may be held to the heel of a Resurfacer, and collect a large part of the grindings.

When an "Ideal" or "Perfect" Precision Grinder is used, a piece of steam hose may be split open six or eight inches; then by cutting a hole the size of the face of the Tool Type Resurfacer, it may be slipped over the Resurfacer and attached to an IDEAL Blower and Suction Device, which is an excellent means of collecting most of the grindings.

Paper collars may be mounted in front of risers when much cutting is done. An air hose or IDEAL Blower may be directed on the commutator to blow the grindings away. Usually the draft is from the windings toward the commutator. When the reverse is present the draft may be cut off by means of a cloth curtain.

Ideal Commutator Resurfacers For Lathe Use

By means of a clamping device an IDEAL Commutator Resurfacer of the Tool Type may be mounted exactly as a steel tool for turning of commutators in a lathe. This method is especially valuable for commutators just slightly out of round or just ridged and a cut to the depth of the undercutting is not necessary. The IDEAL Commutator Resurfacers do not drag copper from segment to segment.

This method is also used for polishing, burnishing and the removal of tool marks.

COMMUTATOR TROUBLES AND REMEDIES

The following outline embraces in a general way a majority of troubles on the various types of electrical machines having commutators and slip rings. It includes also the best known remedies for each trouble.

Sparking

On most machines commutator troubles are manifested by sparking at the brushes. Some of the more common causes and their remedies are listed here:

1. Brushes off Electrical neutral.
- (a) Shift to neutral by trial.
- (b) Set on neutral by means of volt meter.

2. Insufficient pressure on brushes.
- (a) Increase pressure by trial and consult with brush manufacturer.

3. High mica.
- (a) Resurface commutator with IDEAL Hand Type Resurfacer of medium or finish grade.
- (b) Put commutator in perfect shape with IDEAL Hand Type Resurfacer of medium or finish grade and by undercutting mica.

4. Accumulation of oil and dirt in slots on commutator.
- (a) Clean slots with IDEAL Slot Scraper.
- (b) Consult manufacturer of machine if oil comes from bearings.
- (c) Consult manufacturer of brushes if oil comes from brushes.

5. Brushes tight in holders.
- (a) Clean holders and file off any rough spots.
- (b) File brush surfaces.

6. Brushes not properly seated.
- (a) Grind brushes to full seat, using IDEAL Brush Seaters.
- (b) See that all brush holders are securely fastened to studs.

7. Brushes spanning too many bars.
- (a) Trim down faces of brushes.
- (b) Use thinner brushes if holders are clamp type.

8. Incorrect brush spacing.
- (a) Check spacing by counting bars between studs or placing a strip of paper around commutator with divisions marked off equal to the number of studs.
- (b) Correct spacing by moving brush studs or brush holders on the studs.

9. Brush studs not parallel with the communtator bars.
- (a) Bend brush studs.
- (b) Grind or shim under bolts that fasten studs to yoke.

10. Poor adjustment of interpoles.
- (a) Consult manufacturer of machine.

11. Too low contact drop of brushes.
- (a) Consult manufacturer of brushes.

12. Open circuit in armature coil.
- (a) Rewind that part of armature.

13. Loose end connection.
- (a) Resolder all defective connections.

14. Short circuited field coil.

15. Field opposing one another.

16. Eccentric commutator or ring.
- (a) Grind commutator or ring with IDEAL Tool Type Resurfacers mounted in "Midget," "Perfect" or "Ideal" Precision Grinder.

17. Worn bearings.
- (a) Shim or renew bearings.

18. Unequal air gaps.
- (a) Shim or renew bearings if from worn bearings.
- (b) If bearings do not remedy this consult manufacturer.

19. Short circuit current between brush studs caused by unbalanced armature winding.
- (a) Consult manufacturer of machine.

20. Incorrect adjustment of interpole or series field shunt.
- (a) Consult manufacturer of machine.

21. Unstable foundation.

22. Poor belt lacing.
- (a) Relace.
- (b) Use continuous belt.

23. Pound of reciprocating engine driving the machine.

Blackening of Commutator or Rings

Blackening is very often a direct result of sparking. See general heading "Sparking." Some of the following reasons are responsible for this condition:

COMMUTATOR TROUBLES AND REMEDIES

(continued)

1. *Too much lubricant in brushes.*
   (a) Use more abrasive brushes.

2. *Oil from bearings.*
   (a) Wipe commutator or ring with clean canvas.

3. *Surges of load current.*
   (a) Use brush of higher carrying capacity.
   (b) If possible add more brushes to machine.

Flat Spots

This condition is frequently the cause of poor commutation, excessive noise and brush wear. Flat spots on rings are equally destructive to brushes and should in any case be remedied before serious injury results to the machine. The majority of troubles encountered are listed below. These are usually accompanied by sparking at the brushes:

1. *High bar.*
   (a) Tighten commutator bolts and turn or grind commutator with IDEAL Tool Type Resurfacers mounted in "Perfect" or "Ideal" Model Precision Grinder.

2. *Low bar.*
   (a) Grind commutator using IDEAL Hand Type Resurfacers, the width at least 3 times the width of the flat spot, or use Grinder as above.

3. *Eccentric commutator or ring on high speed machines causes brushes to jump at high spots.*
   (a) Grind commutator or ring as above.

4. *Surges of load current.*

5. *Difference in hardness of mica or commutator bars.*
   (a) Grind commutator, placing in perfect condition, and undercut mica and use non-abrasive brushes.

6. *Mechanically unbalanced armature.*

Pitting and Burning of Brush Faces

1. *Brushes of insufficient carrying capacity.*
   (a) Consult manufacturer of brushes.

2. *Too low brush pressure.*
   (a) Increase pressure by trial and consult with brush manufacturer.

3. *Chattering of brushes.*
   (a) See general heading "Chattering."

4. *Selective action due to unequal brush pressure.*
   (a) Equalize pressure on all brushes.

5. *Short circuit currents.*
   (a) See No. 7 under general heading "Sparking."

Picking Copper

1. *Heavy short circuit currents.*
   (a) Brushes off neutral.
   (b) Incorrect brush spacing.
   (c) Brushes too thick.
   (d) Unequal air gaps.
   (e) Too low contact drop of brushes.
   (f) Crooked brush studs.
   (g) Unbalanced armature winding.

2. *Collection of fine copper particles by lubricant under the brushes.*
   (a) Wipe commutator or ring with clean canvas and sandpaper brush faces.

3. *Sand under brush faces.*
   (a) Wipe brush faces carefully after grinding brushes and commutator.

4. *Commutator or ring not thoroughly cleaned after turning.*
   (a) Use IDEAL Commutator Resurfacer to finish surface after turning with steel tool.

5. *Abrasive action of brushes.*
   (a) Undercut mica and use non-abrasive brushes.

6. *Electrolytic action.*
   (a) Consult manufacturer of brushes.

Overheating

Overheating of a machine or commutator is very often due to severe sparking. The remedies for this condition may be found under the general heading "Sparking." Some of the following reasons are also responsible for excessive temperature rises.

1. *Overloads.*
   (a) Reduce load if machine is overloaded.
   (b) Use brushes of higher carrying capacity if brushes are overloaded.

2. *Short circuit currents.*
   (a) See No. 1 under general heading "Picking Copper."

3. *High friction brushes.*
   (a) Undercut mica and use low friction brushes.

4. *Too high or too low brush pressure.*
   (a) Correct by trial and consult with brush manufacturer.

5. *Unequal brush pressure.*
   (a) Equalize pressure on all brushes to prevent selective action and subsequent heating.

6. *Improper ventilation.*
   (a) Supply clean, cool air with fans or ventilating duct.

7. *Chattering of brushes.*
   (a) See general heading "Chattering."
8. *Commutator too small.—(Consult manufacturer).*
9. *Service too severe—such as too many starting periods —or too many reversals.*

Chattering

Often noisy operation and chipping of brushes can both be traced to chattering:

1. *Rough commutator or ring.*
   (a) Grind commutator or ring with IDEAL Hand Type Resurfacer of grade suitable to condition of commutator.
2. *High mica.*
   (a) Grind commutator with IDEAL Hand Type Resurfacer of medium or finish grade, and undercut mica.
3. *High bars.*
   (a) Tighten commutator bolts and grind commutator with IDEAL Tool Type Resurfacer mounted in "Midget," "Perfect" or "Ideal" Grinder.
4. *Flat spots.*
   (a) Grind commutator or ring with IDEAL Hand Resurfacer with width at least three times width of flat spot.
   (b) If flat spots are too large for hand resurfacing grind commutator or ring with IDEAL Tool Type Resurfacers mounted in "Midget," "Perfect" or "Ideal" Grinders.
5. *Insufficient brush tension on machines subject to severe vibration such as street railway motors and industrial trucks.*
   (a) Consult with brush manufacturer.
6. *Brushes loose in holders.*
   (a) Replace brush holders if due to worn holders.
7. *Wide slots with thin brushes.*
   (a) Fill slots with commutator cement.
8. *Brushes set at wrong angle.*
   (a) Consult manufacturer of machine.
   (b) Consult manufacturer of brushes.

Weak Field—Faulty commutation is often the result of a weak field. The most common symptoms are sparking at the brushes, poor voltage regulation on the generator and poor speed regulation on the motor.

Short Circuits and Open Circuits in Field Coil—In a shunt wound generator a short circuited field coil will cause a reduction in the generator voltage and in a motor an increase in speed. Pronounced sparking at the adjacent brush studs will also take place. All the field coils including the defective one will show a higher temperature than under normal conditions. The short circuit in the series coil of the generator will cause the machine to drop its voltage and also to drop its load if operating in multiple with other units. A rise in speed will be noticed in a motor.

An open circuit in the field coil will result in a drop in voltage on a generator and an increase in speed on a motor.

Opposing Fields—Opposing fields will result in severe sparking and blackening of the commutator.

Open Circuit in the Armature—This condition causes blackening and burning of the commutator segment connected through the open-circuited coil. All the brushes on each stud will flash and spark successively around the machine as this bar passes under them. On a generator a variation in voltage will be noticed. The speed regulation on a loaded motor will be poor.

Grounds—Sparking from grounds occurs at all brushes and studs and is usually accompanied by glowing and heating of the brushes.

Poorly Balanced Armature—A poorly balanced armature will cause vibration resulting in sparking at the brushes. The sparking is of a mechanical nature and exists at all loads. It lacks the snap of the electrical spark and does no particular harm to the brushes or commutator. All the brushes may spark at the same time or they may spark successively around the commutator if an intermittent vibration is set up in the brush rigging.

Loose Pole Pieces—Loose pole pieces, either main or commutating, cause poor voltage and speed regulation and faulty commutation.

Grounds or Short Circuits in Compensating Winding—Ground or short circuits in the compensating or pole face winding will result in poor commutation.

General Rules—Leave all switches open when machine is not running.

At all times keep the generator clean and free from oil and dust, especially from copper or carbon dust. With high-voltage machines a small accumulation of dust on the windings may be the cause of serious burn-out.

Keep small pieces of iron and bolts and tools away from the frame. Any such fragment attracted to the pole of a field magnet may jam between the armature and pole and cause serious damage.

Frequently give the machine a thorough inspection. The higher the voltage of the generator the more often this should be done.

Starting Generators—See that the bearings are well supplied with oil and that the oil rings are free to turn. Inspect all connections for loose screws or wires.

Start slowly. See that the oil rings are revolving properly.

Turn in all resistance in the field rheostat, then bring the machine up to speed.

Adjust the rheostat for the normal voltage of the generator.

Throw on the load cautiously.

Causes of Insufficient Voltage—The following causes may prevent generators from developing their normal voltage:

The speed of the generator may be below normal.

The switchboard instruments may be incorrect and the voltage may be lower than that indicated, or the current may be greater than is shown by the readings.

The series field may be reversed, or part of the shunt field reversed or short-circuited.

The brushes may be improperly positioned relative to the poles.

A part of the field rheostat or other unusual resistance may be in the field circuit.

Reversing Polarity—To change the polarity, if a generator keeps the same rotation, it is necessary to reverse the magnetism in the field circuit which is done by exciting the shunt field in the opposite direction.

Reversing Rotation—To change the rotation but not the polarity, it is necessary to reverse the polarity or the armature leads. The simplest method, and the one recommended, is to reverse the leads to the armature and the leads to the commutating-pole winding. In all commutating-pole machines, it must be borne in mind that the direction of current in the armature and commutating-pole windings always bear the same relation to each other, and if the armature current is reversed for any reason, the commutating-pole coils must be reversed.

To Parallel—To throw a machine on the line in "parallel" with machines already operating:

Bring the machine up to normal speed.

With a voltmeter connected to its terminals gradually bring up the voltage by cutting out resistance in the rheostat until approximately the voltage of the other machines is reached. Throw in equalizer switch. Adjust voltage, if necessary. Throw in main switches. Adjust rheostat till generator takes its proportion of the load. The proper voltage to obtain before throwing a generator in parallel with others can be found by trial. It may vary slightly from the voltage depending on local conditions, regulations, characteristics of machines, etc.

Excitation of D. C. Generators—When starting up, a generator may fail to excite itself. This may occur even when the generator operated perfectly during the preceding run. It will generally be found that this trouble is caused by a loose connection or break in the field circuit, by poor contact at the brushes due to a dirty commutator or perhaps by a fault in the rheostat, or incorrect position of brushes. Examine all connections; try a temporarily increased pressure on the brushes; look for a broken or burnt out resistance coil in the rheostat. An open circuit in the field winding may sometimes be traced with the aid of a magneto bell; but this is not an infallible test as some magnetos will not ring through a circuit of such high resistance as some field windings have even though intact. If no open circuit is found in the rheostat or in the field winding, the trouble is probably in the armature. But in event it is found that nothing is wrong with the connections or the winding it may be necessary to excite the field from another generator or some other outside source.

A very simple means for getting a compound-wound machine to pick up is to short-circuit it through a fuse having approximately the current capacity of the generator. If sufficient current to melt this fuse is not generated, it is evident that there is something wrong with the armature, either a short-circuit, or an open circuit. If however, the fuse has blown, make one more attempt to get the machine to excite itself. If it does not pick up, it is evident that something is wrong with the shunt winding or connections.

If a new machine refuses to excite and the connections seem to be all right, reverse the connections, i.e., connect the wire which leads from the positive brush to the negative brush and the wire which leads from the negative brush to the positive brush. If this change of connections does no good, change back and locate the fault.

To Shut Down Generator—Reduce the load as much as possible by throwing in resistance with the field rheostat.

Throw off the load by opening the circuit-breaker, if one is used, otherwise open the feeder switches and finally and main generator switches.

Shut down the driving machine.

Wipe off all oil and dirt, clean the machine and put it in good order for the next run.

OPERATION OF DIRECT CURRENT GENERATORS

(continued)

Opening of Feeder Circuits—If a line fuse blows or a circuit-breaker opens, first open the switch controlling that line, and then replace the fuse and close the breaker. The switch may now be closed again. If the circuit opens the second time, there is something wrong on the line—probably a short-circuit—and this should be corrected at once.

If for any reason, such as a short-circuit or a heavy overload on the line, the circuit-breaker or switches hold an arc when opened, such an arc should be extinguished if possible by using dry sand, a supply of which should always be kept conveniently at hand. In case the arc cannot be extinguished in this manner, as a last resort, open the field circuit of the machine or shut the generator down entirely. When the arc forms on the machine or on the generator side of the breakers, a shut-down is generally imperative, but should not be made if it can possibly be avoided.

Brushes—The ends of all brushes should be fitted to the commutator so that they make good contact over their entire bearing face. This can be most easily accomplished after the brush holders have been adjusted and the brushes inserted. Use an IDEAL Brush Seater holding it at the heel of the brush and touching it to the revolving surface of the commutator. The friction releases some of the brush seater material which is carried by the revolving surface under the brush. This material quickly removes enough of the brush to give it a perfect seat true to every variation of the commutating surface. The brush should be held down hard by hand against the commutator while the Brush Seater need be touched only lightly or intermittently so that a small amount of material is sent under the brush at a time. It will be found that by this means a satisfactory contact is quickly secured, each set of brushes being similarly treated in turn. If the brushes are copper plated their edges should be slightly beveled so that the copper does not come in contact with the commutator.

Commutator surface speeds of direct-current turbo-generators are somewhat higher than for standard machines of other types, owing to their large diameter. For this reason it is usually necessary to use a self-lubricating brush. Brushes in the market that have this characteristic are ordinarily of graphite nature and are weaker mechanically and hence more easily broken than the carbon brushes for lower-speed machines. They are also softer, and reasonable care should be exercised in handling them when the machine is taken apart or assembled. Rough handling or carelessness will probably cause breakage.

With graphite brushes of good quality, no oil should be necessary for lubricating the commutator; and as a rule oil will have a tendency to "gum" the surfaces of the brushes, unless used very sparingly.

Besides maintaining the brushes in the proper position, the following points should be observed:

Make frequent inspection to see that—

Brushes are not sticking in holders.

Pig-tail shunts are properly attached to brushes and holders.

Tension is adjusted as brush wears.

Copper plating is cut back so it does not make contact with the commutator.

Worn-out brushes are replaced before they reach their limit of travel and break contact with the commutator.

Remove any free copper picked up by the face of the brush.

Commutator—The commutator is perhaps the most important feature of the whole machine as it is most sensitive to abuse. Under normal conditions, it should require little attention beyond frequent inspection. The surface should always be kept smooth by using an IDEAL "Finish" Grade Resurfacer which has been especially adapted for periodic application. As its grain size is the equivalent of 00 sandpaper, it cuts only a hair's breadth of copper. If the commutator should become badly roughened, it is recommended that the "Coarse" Grade IDEAL Resurfacer be used for rapid cutting, or if the commutator is extremely bad, portable Precision Grinders are available, which mount on the brush arm of machines and insure extreme accuracy, often to .001 of an inch.

Emery cloth or paper should never be used because the emery grains become embedded in the copper bars and brushes. Also it must be kept in mind that sandpaper does not grind down high mica, *whereas there is a slight tendency of undercutting mica when an IDEAL Resurfacer is used.*

When grinding a commutator, it is advisable to raise brushes and it is important that the commutator is PERFECTLY CLEAN from oil or grease.

Under normal conditions the commutator should take on its normal color and become highly polished after a few week's operation and to get the proper finish, we caution against using products that give an artificial finish. The best and desired finish is ordinarily placed on the commutator by the carbon brushes.

Trouble is sometimes experienced from the burning out of the mica insulation between segments. This is most commonly caused by allowing the mica to become oil soaked, or by the bars loosening and thus allowing foreign conducting material to work its way between them. It is rarely, if ever, definitely traced to excessive voltage between bars. When this burning does occur, it may be effectively stopped by scraping out the burned mica and filling the space with IDEAL Commutator Cement.

Even with the most careful maintenance, high mica will sometimes develop and start sparking, which burns away the copper and aggravates the difficulty. By prompt action, serious damage can be prevented by cutting away the mica to a depth approximately the width of the mica. Special IDEAL Slotting Files are offered for undercutting mica in small commutators and the IDEAL Motor Driven Mica Undercutter is offered for shops which have considerable undercutting to do.

For Further Details Telling How to Care For Commutators, Refer to Different Sections in the Forepart of This Catalog

OPERATION OF DIRECT CURRENT GENERATORS

(continued)

Bearings—Most machines have self-oiling bearings. The well should be filled to such a height that the rings will carry sufficient oil upon the shaft. If the bearings are too full, oil will be thrown out along the shaft. The oil should be renewed about once in six months, or oftener if it becomes dirty and causes the bearings to heat. Bearing housings are usually supplied with outlet holes for overflow of the oil. The oil should be kept slightly below the level of the holes.

A recent development in the direction of better operation is the adoption of ball bearings for small motor and generator shafts—particularly in what is commonly known as fractional h.p. sizes, up to 1 h.p. In a motor so equipped, all the wear comes on hardened steel balls and ball races; and, where a ball bearing is used that is adapted to the high speeds involved, beneficial results have been noted in reduced wear, longer life, better lubrication, easier cleaning, less vibration, maintained adjustments, and a higher efficiency due to the smaller air gap made possible.

Belts—The belt on a belt-connected machine should be tight enough to run slowly without slipping, but the tension should not be too great or the bearings will heat. Belts should run with the inside lapping, not against it, and the joints should be dressed smooth, so that there will be no jarring as it passes over the pulley. The crowns of driving and driven pulleys should be alike as "wabbling" of belts is sometimes caused by pulleys having unlike crowns. If the wabbling is caused by bad joints, they should be broken and cemented over again. A wave motion of flapping is usually caused by slippage between the belt and pulley resulting from grease spots, etc. It may, however, be a warning of an excessive overload. This fault may sometimes be corrected by increasing tension, but a better remedy is to clean the belt. A back and forth movement on the pulley is caused by unequal stretching of the edges of the belt. If this does not cure itself shortly examine the joints. If they are unevenly made and remain so, the belt is bad and should be discarded.

Sparking—at the brushes may be due to any one of the following causes:

The machine may be overloaded.

The brushes may not be set exactly at the point of commutation. A position can always be found where there is the smallest amount of sparking, and at this point the brushes should be set and secured.

The brushes may be wedged in the holders or have reached the end of their travel.

The brushes may not be fitted to the circumference of the commutator.

The brushes may not bear on the commutator with sufficient pressure.

The brushes may be burnt on the ends.

The commutator may be rough; if so, it should be smoothed with an IDEAL Resurfacer.

A commutator bar may be loose or may project above the others.

The commutator may be dirty, oily or worn out.

The carbon brushes may be of an unsuitable grade.

The brushes may not be equally spaced around the periphery of the commutator.

Some brushes may have extra pressure and may be taking more than their share of the current.

High mica is the most common cause of sparking.

Vibration of the brushes.

These are the more common causes, but sparking may be due to an open circuit or loose connection in the armature. This trouble is indicated by a bright spark which appears to pass completely around the commutator and may be recognized by the scarring of the commutator at the point of open circuit. If a lead from the armature winding to the commutator becomes loose or broken it will draw a bright spark as the break passes the brush position. This trouble can be readily located, as the insulation on each side of the disconnection bar will be more or less pitted.

The commutator should run smoothly and true, with a glossy surface.

Heating of Armature—Heating of the armature may develop from any of the following causes:

Too low speed.

Too high voltage.

Too great forward or backward lead of brushes.

Overload or too great a load.

Short circuit in coils or partial short-circuit of one coil.

Grounds on armature or commutator.

Hot Box—or warm bearing is probably due to one of the following causes:

Excessive belt tension.

Failure of the oil rings to revolve with the shaft.

Rough bearing surface.

Improper fitting of the journal boxes.

Bent shaft.

Use of poor grade or dirty oil.

Bolts in the bearing cap may be too tight.

End thrust, due to improper leveling. A bearing may become warm because of excessive pressure exerted by the shoulder of the shaft against the side of the bearing.

End thrust, due to the magnetic pull, rotating part being "sucked" into the field because it extends beyond the field pole further at one end than at the other.

Excessive side pull, because the rotating part is out of center.

If a bearing becomes hot, first feed heavy lubricant freely, loosen the nuts on the bearing cap and then, if the machine is belt-connected, slacken the belt.

Where properly mounted ball bearings of good design and materials are used, most (if not all) of the above mentioned causes of overheated and worn bearings are eliminated. One of the greatest advantages of such ball bearings is that their mounting usually provides a capacity for lubricant ample for operation over long periods, without replenishing. This in itself is a safeguard against the neglect which too often lies at the root of motor troubles. Many manufacturers are now equipping their small motors, with ball bearings—largely because of the longer life thus assured.

DEFINITIONS OF ELECTRICAL TERMS

Air Gap: Air space in a magnetic circuit through which the magnetic flux must pass. It should be as short as possible as the reluctance of air is very high.

Ampere: The unit of current flow of electricity. It means the same with reference to electricity, as does the number of gallons per minute, when referring to the flow of water through a pipe. A 60-watt, 110-volt tungsten lamp takes 0.545 ampere to make it give the proper light.

Ampere-Hour: This expression is used to describe the capacity of a storage battery and corresponds to the number of gallons a tank will hold when talking about water. Ampere-hours are obtained by multiplying the number of amperes flowing by the length of time in hours which they flow. Example: How many ampere-hours are required to light four 60-watt, 110-volt tungsten lamps for 3 hours? As stated above one lamp takes 0.545 ampere, so four lamps takes 4 times 0.545 or 2.18 amperes. 2.18 times 3 equals 6.54 ampere-hours.

Ampere-Turns: Turns of wire in a coil times the ampere current flowing. It is used as a measure of magnetizing force, which varies directly as the number of ampere-turns.

Apparent Load or Apparent Power: Current in amperes times electromotive force in volts gives apparent load in watts. Used for alternating current circuits because the current flow is not in phase with the electromotive force, hence, amperes times volts does not give the real energy load.

Automatic Battery-Charging Switch: An automatic switch for opening the circuit between the battery and the generator when for any reason the generator voltage drops below battery voltage. This switch also closes automatically when the generator voltage is at the proper value for charging the battery or lighting the lamps.

Candlepower: The unit for measuring strength of a source of light. The usual practical standard is a carefully standardized incandescent lamp, comparison being made by means of a photometer. Ordinary tallow candle gives about 1 c.p.; flat wick oil lamp, 6 c.p.; 60-w. tungsten bulb, 40 c.p.

Foot-Candle: Same as candle-foot. The illumination produced at 1 ft. from a light of 1 candlepower; illumination varies as the strength of the light source and inversely as the square of the distance from that light source.

Circular-Mil: The area of a circle 0.001 in diameter. The circular mils area of a wire varies as the square of the diameter: For No. 36 B & S wire, the diameter is .005 in. and the area 25 circular-mils. For No. 14 wire, the diameter is 0.06408 in. or 64.08 mils and the area is 64.08^2 or 4107 cir. mils.

Coil Wound Motor: One in which the armature winding is made up in formed coils then placed on the core and the coil leads connected in proper order.

Commutating Pole: A small pole piece on motor generator, usually placed midway between the main pole pieces and provided with a winding to neutralize the magnetic effect of the armature current so as to avoid distortion of the magnetic field with change of load.

Compensating Winding: A winding placed on the field poles either to increase voltage as load increases, thus making up for loss of potential in armature and transmission lines, or on one tip of the poles to offset the magnetic effect of armature current and prevent distortion of the magnetic field. The term is also used for alternating-current machines where the compensating current is rectified from alternating, as distinguished from compound winding for direct-current machines.

Compound-Wound: Applied to direct-current machines having a series field coil to vary the field magnetism as the load varies, in addition to a shunt field coil for main excitation. The compound coil may be proportioned to add just enough voltage to make up for drop in potential through the armature, (flat compounded), or it may increase the voltage as load increases so as to make up for line drop, (over compounded).

Condenser: An electrical device for storing a charge of electricity and returning it to the line. It is used to balance the inductance of a circuit, since its action is opposite in phase to that of inductive apparatus, i.e., it throws the current ahead of the e.m.f. in phase. It is made of alternate plates of tinfoil and insulating material, the size of plates and thickness of insulation determining the capacity for holding electric charge. Capacity is measured, practically, in microfarads or millionths of a farad.

Dielectric: A non-conducting or insulating material. The dielectric value of a material is measured by comparing it with that of a like thickness of air taken as unity. Glass is 3 to 8; porcelain, 4.4; treated paper, 2 to 4; paraffin and various forms of rubber, 2.2 to 2.5; mica, 6; water, 80.

Electro-Magnet: A core of iron or steel, solid or laminated, surrounded by a coil of wire through which electric current is passed. The coil, carrying current, produces a magnetic field and the core becomes a magnet. Without the core, the coil is known as a solenoid.

Electrolyte: The liquid used in a storage battery. It consists of a small portion of sulphuric acid mixed with pure distilled water.

Exciting Current: Current used for energizing the field coils of a motor or generator to create magnetic flux in the pole pieces.

Hysteresis: The quality of iron which causes lagging of the induced magnetism behind the magnetizing force. When the magnetic field is reversed, this causes a loss varying with the number of reversals per second, with the 1.6 power of the maximum value of magnetic density in the iron and with the volume of iron in the magnetic field.

DEFINITIONS OF ELECTRICAL TERMS

(continued)

Induction Motor: One in which rotor current is set up by transformer action from alternating currents supplied to the stator windings. The rotor currents are induced by those in the stator, hence the name—induction motor.

Inductance: The coefficient of self-induction of a circuit. The effect is to cause current to lag behind electromotive force in phase. It depends on the size and shape of the circuit, cross-section and shape of conductor, magnetic properties of the conductor and the surrounding medium and on the frequency of the current reversal and resistance of the conductor. It is, therefore, difficult to compute except for simple wire circuits suspended in air. The unit for measurement is the *henry,* or the *millihenry* (1/1000 of a henry).

Line Loss: Energy used up in overcoming the resistance of the transmission line to flow of electric current. Its result is drop in voltage, which varies with resistance of the line and as the square of the current flowing. Also known as I^2R loss.

Magnetic Density: Magnetic lines per unit of area of cross-section of the magnetic circuit, also known as magnetic induction. One magnetic line per square of the centimeter is known as a *gauss* and the magnetic density, B, in gausses is equal to the magnetizing force, H, times the permeability of the material at the point considered. Permeability of air is 1.

Magnetic Flux: Total of magnetic lines in a circuit. One line is known as a *maxwell* and the magnetic flux is equal to the average magnetic density times the area of cross-section of the magnetic circuit. Except for leakage, the magnetic flux will be the same at all parts of a magnetic circuit but the magnetic density will vary with the area of cross-section of different parts. The symbol is F.

Magnetizing Force: The force per unit of length of solenoid. It depends on the number of turns and the current flowing. The symbol is H.

Magnetomotive Force: The total magnetizing force developed by a solenoid, or required to set up a given density through a magnetic circuit or part of a circuit. The magnetomotive force for each part of a circuit will depend on the material in that part of the circuit and the length of the magnetic path through it. The unit in the C.G.S. system is the *gilbert* but it is customary to express magnetomotive force in ampere-turns either per inch of length of the magnetic path or total for the circuit.

Mil: 1/1000 of an inch.

Ohm: The unit of electrical resistance about equivalent to the resistance of 400 ft. of common iron telegraph wire.

Phase: The relative time of change in values of current or electromotive force. Values which change exactly together are in phase. Difference in phase is expressed in degrees, a complete cycle or double reversal being taken as 360 degrees. 180 degree phase difference is complete opposition in phase.

Permeability: The ratio of magnetic induction or density in a magnetic circuit to the magnetizing force. It is the opposite of reluctivity and is denoted by symbol *m.*

Phase Advancer: A synchronous motor used as a condenser to advance the phase of the lagging current in a circuit and bring it more nearly in phase with the electromotive force.

Photometer: An apparatus for measuring the intensity of a source of light by comparison with a known standard source. Various methods of comparison are employed to compare the illumination from two sources.

Potential: Voltage, or difference in electric pressure between two parts of a circuit or between a circuit and an outside point.

Power Factor: The relation of *real* to *apparent power* in an alternating-current circuit. It depends on the difference in phase between current and electromotive force and is equal to the cosine of the angle of phase lag or lead of the current.

Primary Cell: A battery cell which generates electromotive force by direct chemical action of the electrolyte on a metal, the metal usually being destroyed in the process.

Real Power or Actual Power in an alternating current circuit is that which is measured only with a wattmeter.

Regulation: Steadiness of maintaining the value of electromotive force or current. Controlled by generator or transformer action or by a special regulator. Good regulation should hold voltage variation within 3 percent of normal.

Repulsion Motor: An a.c. motor which operates by repulsion of armature conductors by the stator field. It has low starting torque on full load, tendency to spark and rather low efficiency.

Reluctance: Magnetic resistance or opposition to the passage of magnetic lines of force. Unit reluctance, the *oersted,* is that of a cubic centimeter of air. It is the ratio of magnetomotive force to magnetic flux. It is practically the same for all non-magnetic materials but, for iron and steel, it increases with the increase of magnetic density although not in direct proportion.

Resistivity: The specific resistance of a substance; the resistance in ohms of a centimeter cube of the material to flow of current between opposite faces.

DEFINITIONS OF ELECTRICAL TERMS

(continued)

Rheostat: A resistance introduced in a circuit to cause drop from voltage applied to the point where current is used. It may be metal or liquid and is utilized chiefly for regulating the e.m.f. on field coils and motor armatures.

Rotary Converter: A machine with connections to the armature for both direct and alternating current, used for changing either form of current to the other. This is properly a synchronous converter, as converters with double armature windings are used for changing voltage of direct current, for changing frequency and for changing phase.

Rotor: The rotating part of an alternating current motor. Usually the secondary of an induction motor but may be applied to the revolving field of a synchronous motor.

Sag: In transmission lines, the distance that the lowest point of a span is below the straight line between supports.

Series Wound: Applies to generators or motors having the armature and field windings connected in series.

Shunt Wound: Applies to generators or motors having the field winding in shunt across the armature.

Slip Ring: A solid ring with brush bearing on it for conveying alternating current to or from the armature or rotor of an alternating current machine. Also used for feeding current to the revolving field of a synchronous motor.

Specific Gravity: This term is used to express the relative weight of any substance with reference to the same volume of pure water. If a gallon of any substance weighs twice as much as a gallon of water, its specific gravity is said to be 2. The specific gravity of the electrolyte in a storage battery changes during the charge and discharge and by measuring the specific gravity of the electrolyte, it is possible to tell whether the battery is fully charged, partly charged or wholly discharged.

Squirrel Cage: Winding for a rotor of an induction motor made of solid bars joined to connecting rings at each end.

Static Condenser: See Condenser.

Synchronous Condenser: A synchronous motor with over-excited field, throwing the current ahead of the e.m.f. in phase, thus giving a condenser effect. Used for raising the power factor of an inductive circuit.

Synchronous Motor: An alternating current motor having the field excited by direct current. It runs at a constant speed determined by the number of poles and frequency of the current supply. It must be started and brought to speed by some external power and without load; frequently the d.c. exciter, mounted on the same shaft, is used as a motor for starting.

Three-Phase: A term applied to circuits or machines carrying three currents at 120 deg. apart in phase.

Torque: Turning effort or moment applied to or exerted by an armature or rotor. It is measured in pound-feet and depends on the field strength, number of conductors on the armature and current carried by the conductors.

Two-Phase: A term applied to circuits or machines carrying two currents, usually *90* deg. apart in phase.

Volt: The unit of electrical pressure similar to the pounds pressure on a steam gauge. Most farm lighting plants operate with 32 volts, while most city lighting systems operate with 110 volts pressure. The "Voltage" is the pressure which causes the electricity to flow through the lamps heating the filament to incandescence, thereby giving light.

Kilovolt: The kilovolt is 1000 volts.

Watt: The unit of electric power; volts x amperes equal watts. Watts correspond to horsepower; 746 watts equal one horsepower. A 60-watt, 110 volt tungsten lamp takes 0.545 amperes, therefore, it takes 110 x 0.545 equal 60 watts of power. It is called a 60-watt lamp for that reason.

One electrical horsepower is equal to 746 watts.

One kilowatt is equal to 1,000 watts.

To find the watts consumed in a given electrical circuit, such as a lamp, multiply the volts by the amperes.

To find the electrical horsepower required by a lamp, divide the watts of the lamp by 746.

To find the actual brake horsepower approximated by an engine when directly connected to a generator, multiply the amperes by the voltage and divide by *660,* which will give approximately the brake horsepower of the engine.

If a belted type of engine, follow the above rule but divide the total number of watts by *550* instead of 660 which will give the horsepower developed by the engine.

Wattless Component: That part of the current in an alternating current circuit assumed to be 90 deg. phase to the e.m.f., hence resulting in no useful work.

Allowable Current Carrying Capacities of Solid and Stranded Wires

(National Electric Code)

SOLID WIRE						STRANDED WIRE						
B. & S. No.	Diameter of Solid Wires, Mils	Area Circular Mils	Allowable Carrying Capacities, Amperes			Strands		Cable		Allowable Carrying Capacities, Amperes		
			Rubber Insulation	Varnished Cloth Insulation	Other Insulation	No. of Strands	B. & S. Gage No.	Area in Circular Mils	Outside Dia. Over Copper	Rubber Insulation	Varnished Cloth Insulation	Other Insulation
6	162.0	26,250	50	60	70	7	22	4,490	.075	15	18	20
5	181.9	33,100	55	65	80	7	20	7,150	.096	20	25	25
4	204.3	41,740	70	85	90	7	18	11,370	.120	25	30	35
3	229.4	52,630	80	95	100	7	16	18,080	.153	35	40	50
2	257.6	66,370	90	110	125	7	14	28,740	.192	50	60	70
1	289.3	83,690	100	120	150	7	12	45,710	.253	70	85	90
0	325.0	105,500	125	150	200	7	11	58,000	.273	80	95	110
00	364.8	133,100	150	180	225	7	10	72,680	.306	90	110	130
000	409.6	167,800	175	210	275	19	14	78,030	.320	100	120	150
.....	.....	200,000	200	240	300	19	13	98,380	.360	125	150	175
0000	460.0	211,600	225	270	325	19	12	124,900	.405	150	180	210
.....	.....	250,000	250	300	350	19	11	157,300	.455	175	210	250
.....	.....	300,000	275	330	400	19	*	217,500	.540	225	270	325
.....	.....	350,000	300	360	450	19	9	248,700	.570	250	300	350
.....	.....	400,000	325	390	500	37	11	360,400	.637	275	330	400
.....	.....	500,000	400	480	600	37	*	347,500	.679	300	360	450
.....	.....	600,000	450	540	680	37	10	381,200	.714	325	390	500
.....	.....	700,000	500	600	760	37	*	484,300	.798	400	480	600
.....	.....	800,000	550	660	840	61	10	633,300	.918	475	565	700
.....	.....	900,000	600	720	920	61	*	698,000	.963	500	600	750
.....	.....	1,000,000	650	780	1,000	61	9	798,300	1.030	550	660	825
.....	.....	1,100,000	690	830	1,080	61	*	893,100	1.090	600	720	900
.....	.....	1,200,000	730	880	1,150	61	8	1,007,000	1.150	650	780	1,000
.....	.....	1,300,000	770	920	1,220	91	9	1,191,000	1.250	725	870	1,125
.....	.....	1,400,000	810	970	1,290	91	8	1,502,000	1.410	850	1,020	1,350
.....	.....	1,500,000	850	1,020	1,360	127	9	1,660,000	1.480	900	1,100	1,460
.....	.....	1,600,000	890	1,070	1,430	127	8	2,097,000	1.660	1,100	1,300	1,700
.....	.....	1,700,000	930	1,120	1,490							
.....	.....	1,800,000	970	1,160	1,550							
.....	.....	1,900,000	1,010	1,210	1,610							
.....	.....	2,000,000	1,050	1,260	1,670							

*These individual strands are odd sizes not listed in the American or B. & S. Wire Tables.

Direct Current Motor

Fusing, Wiring and Full Load Current Data

115 VOLTS						230 VOLTS					
H.P. of Motor	Approx. Full Load Current-Amperes	Running Fuse	Ampere Capacity of Switch	Minimum Size of Wire B. & S. Gauge	Size of Conduit Underwriters	H.P. of Motor	Approx. Full Load Current-Amperes	Running Fuse	Ampere Capacity of Switch	Minimum Size of Wire B. & S. Gauge	Size of Conduit Underwriters
1	8	10	30	14	½	1	4	5	30	14	½
2	16	20	30	12	¾	2	8	10	30	14	½
3	24	30	30	8	1	3	12	15	30	14	½
5	38	50	60	6	1¼	5	19	25	30	10	¾
7½	58	70	100	3	1¼	7½	29	40	60	8	1
10	75	90	100	1	1½	10	38	50	60	6	1¼
15	112	140	200	00	2	15	56	70	100	4	1¼
20	148	200	200	200,000C.M.	2½	20	74	100	100	1	1½
30	221	275	400	300,000C.M.	3	30	110	140	200	00	2
						40	145	190	200	200,000C.M.	2½
						50	175	225	400	0000	2½
						75	260	350	400	400,000C.M.	3
						100	351	450	600	600,000C.M.	3½

INDUCTION MOTORS—Single Phase, 110, 220, 440, 550 Volts. All Frequencies and Standard Speeds.

	Full Load Amps.				Starting Fuse Amps.				Running Fuse Amps.				Size of Wire, B. & S. and C. M.							
													Rubber Insulation				Other Insulation			
H.P.	110v	220v	440v	550v	110v	220v	440v	550v	110v	220v	440v	550v	110v	220v	440v	550v	110v	220v	440v	550v
.5	6.8	3.4	1.7	1.3	20	10	5	5	10	5	5	5	14	14	14	14	14	14	14	14
1	13 3	6.6	3.3	2.4	35	20	10	5	20	10	5	5	8	12	14	14	8	12	14	14
2	24.8	12.4	6.2	4.9	65	35	20	15	30	15	10	5	6	8	12	14	6	8	12	14
3	36	18	9	7.2	75	45	30	25	45	25	15	10	4	8	10	12	4	8	10	12
5	58.4	29.2	14.6	13.8	120	70	40	30	75	40	20	15	2	6	8	10	2	6	8	10
7.5	85.2	42.6	21.3	17.1	170	85	55	45	100	55	30	25	0	4	6	8	0	4	6	8
10	110	55	27.5	22.4	190	110	70	60	140	65	35	30	00	2	6	6	0	2	6	6
15	162	81	40.5	33	240	160	80	70	200	100	50	40	200,000	0	4	6	000	0	4	6
20	208	104	52	41.6	315	170	110	85	260	130	65	55	300,000	00	2	4	0000	0	2	4
25	258	129	64.5	51.2	385	195	135	100	320	160	80	65	400,000	000	1	2	300,000	0	1	2
30	304	152	76	61	450	225	150	125	380	190	95	85	500,000	200,000	1	2	350,000	00	1	2
35	356	178	89	70	535	270	180	140	445	220	110	90	600,000	211,600	0	1	450,000	000	0	1
40	400	200	100	80	600	300	200	160	500	250	125	110	700,000	300,000	0	0	500,000	200,000	0	0
50	492	246	123	99	740	370	200	200	615	300	150	125	950,000	400,000	00	0	700,000	300,000	0	0

INDUCTION MOTORS—Two Phase, 110, 220, 440, 550 Volts. Four wire* All Frequencies and Standard Speeds

	Full Load Amps.				Starting Fuse Amps.				Running Fuse Amps.				Size of Wire, B. & S. and C. M.							
													Rubber Insulation				Other Insulation			
H.P.	110v	220v	440v	550v	110v	220v	440v	550v	110v	220v	440v	550v	110v	220v	440v	550v	110v	220v	440v	550v
.5	3.1	1.5	.8	.6	10	5	5	5	5	5	5	5	14	14	14	14	14	14	14	14
1	6	3	1.5	1.1	15	10	5	5	10	5	5	5	14	14	14	14	14	14	14	14
2	11	5.6	2.8	2.2	30	15	10	5	15	10	5	5	10	14	14	14	10	14	14	14
3	14.7	7.3	3.6	3.2	40	25	15	10	20	10	5	5	8	12	14	14	8	12	14	14
5	28.6	14.3	7.1	5.3	70	35	20	15	35	20	10	10	6	8	12	14	6	8	12	14
7.5	38.8	19.4	9.7	7.8	80	50	30	20	50	25	15	10	4	8	10	12	4	8	10	12
10	50.2	25.1	12.5	10.8	100	65	35	30	65	30	15	15	2	6	8	10	2	6	8	10
15	73.4	36.7	18.3	15	150	75	45	40	90	45	25	20	1	4	8	8	1	4	8	8
20	95	47.5	23.7	19.5	190	95	60	50	125	60	30	25	0	2	6	8	0	2	6	8
25	118	59	29.5	23.4	200	120	70	60	150	75	40	30	00	2	6	6	0	2	6	6
30	138	69	34.5	27.6	210	140	75	65	165	85	45	35	000	1	4	6	00	1	4	6
35	162	81.3	40.5	32	240	160	80	70	200	100	50	40	200,000	0	4	6	000	0	4	6
40	182	91	45.5	36.4	275	175	90	75	225	115	55	45	211,600	0	4	6	000	0	4	6
50	224	112	56	45	335	180	110	90	280	140	70	55	300,000	00	2	4	250,000	0	2	4
60	268	134	67	53.5	400	200	135	110	335	165	85	65	450,000	000	1	2	300,000	0	1	2
75	332	166	83	66.5	500	250	165	130	420	210	100	80	550,000	0000	0	1	400,000	000	0	1
100	.....	218	109	87.5	.....	330	190	175	.....	270	135	110	.....	300,000	00	0	.....	250,000	0	0
150	.....	320	160	128	.....	480	240	190	.....	400	200	160	.....	500,000	200,000	000	.....	400,000	000	0
200	.....	418	209	169	.....	630	320	250	.....	520	260	210	.....	750,000	300,000	0000	.....	550,000	0000	0000
250	.....	515	257	207	.....	760	385	310	.....	640	320	260	.....	1,000,000	400,000	300,000	.....	700,000	300,000	0000
300	.....	615	307	246	.....	920	460	370	.....	765	385	310	.....	1,300,000	500,000	350,000	.....	900,000	400,000	300,000

Values of current in common wire for a two-phase three wire system would be 1.42 times value given.

INDUCTION MOTORS—Three Phase, 110, 220, 440, 550 Volts. All Frequencies and Standard Speeds.

	Full Load Amps.				Starting Fuse Amps.				Running Fuse Amps.				Size of Wire, B. & S. and C. M.							
													Rubber Insulation				Other Insulation			
H.P.	110v	220v	440v	550v	110v	220v	440v	550v	110v	220v	440v	550v	110v	220v	440v	550v	110v	220v	440v	550v
.5	3.6	1.8	.9	.7	10	5	5	5	10	5	5	5	14	14	14	14	14	14	14	14
1	7	3.5	1.75	1.3	20	10	5	5	10	5	5	5	14	14	14	14	14	14	14	14
2	13	6.5	3.25	2.6	30	20	15	10	15	10	5	5	10	12	14	14	10	12	14	14
3	19	9.5	4.75	3.8	50	30	20	10	20	15	5	5	8	10	14	14	8	10	14	14
5	30.8	15.4	7.7	6.2	70	40	25	15	35	20	10	10	6	8	12	14	6	8	12	14
7.5	44.8	22.4	11.2	9	90	60	30	25	55	30	15	10	4	6	10	12	4	6	10	12
10	58	29	14.5	11.8	120	70	40	30	70	40	20	15	2	6	8	10	2	6	8	10
15	85	42.5	21.2	17.4	170	85	50	40	100	50	25	20	0	4	8	8	0	4	8	
20	110	55	27.5	22.5	180	110	65	55	140	65	35	30	00	2	6	6	0	2	6	
25	136	68	34	27	210	140	70	65	170	85	40	35	000	1	6	6	00	1	6	
30	160	80	40	32	240	160	80	70	200	100	50	40	200,000	0	4	6	000	0	4	
35	188	94	47	37	280	185	95	75	235	120	60	45	250,000	0	2	4	200,000	0	2	
40	210	105	52.5	42	320	190	110	85	260	130	65	55	300,000	00	2	4	211,600	0	2	
50	260	130	65	52	390	200	130	110	300	165	80	65	350,000	000	1	2	300,000	0	1	
60	310	155	77.5	62	470	230	160	125	385	190	95	85	500,000	200,000	0	2	400,000	000	0	
75	384	192	86	77	575	290	175	160	480	240	100	95	700,000	300,000	0	0	500,000	300,000	0	
100	.....	252	126	101	.....	380	190	175	.....	310	150	125	.....	400,000	00	0	.....	300,000	0	
150	.....	368	184	148	.....	550	275	220	.....	460	230	185	.....	650,000	250,000	200,000	.....	450,000	000	
200	.....	484	242	195	.....	720	360	290	.....	600	300	240	.....	900,000	400,000	250,000	.....	650,000	300,000	200,000
250	.....	595	287	240	.....	890	420	360	.....	740	360	300	.....	1,250,000	450,000	350,000	.....	900,000	350,000	300,000
300	.....	710	355	285	.....	1065	530	430	.....	890	445	350	.....	1,600,000	650,000	450,000	.....	1,100,000	450,000	350,000

Wire and Cable Data

1 circular mil is the area of a circle .001 inch diameter = .000,000,7854.

A circle one inch in diameter has an area of 1,000,000 circular mils.

1,000,000 circular mils = 0.7854 square inches.

Stranded cable (without hemp core) on account of cords between wires is 15 per cent larger in diameter than solid conductor for the same circular mils.

A diameter of standard cable of 1.15 inches = 1,000,000 circular mils.

Conversely—

A one-inch stranded cable = 87 per cent of 1,000,000 circular mils, or 870,000 circular mils.

These ratios hold for any stranding of any size wires found in commercial cable.

MISCELLANEOUS DATA

WIRE AND SHEET METAL GAUGES COMPARED

Number of Gauge	Birmingham Wire Gauge	American or Brown and Sharpe Gauge	Roebling's and Washburn & Moen's Gauge	Stub's Steel Wire Gauge	British Imperial Standard Wire Gauge (Legal Standard in Great Britain since March 1, 1884)		U. S. Standard Gauge for Sheet and Plate Iron and Steel (Legal Standard since July 1, 1893)	Number of Gauge
	inch.	inch.	inch.	inch.	inch.	millim.	inch.	
0000000	....	.....	.49	....	.500	12.7	.5	7/0
000000	....	.....	.46	....	.464	11 78	.469	6/0
00000	....	.....	.43	....	.432	10.97	.438	5/0
0000	.454	.46	.393	....	.4	10.16	.406	4/0
000	.425	.40964	.362	....	.372	9.45	.375	3/0
00	.38	.3648	.331	....	.348	8.84	.344	2/0
0	.34	.32486	.307	....	.324	8.23	.313	0
1	.3	.2893	.283	.227	.3	7 62	.281	1
2	.284	.25763	.263	.219	.276	7 01	.266	2
3	.259	.22942	.244	.212	.252	6.4	.25	3
4	.238	.20431	.225	.207	.232	5.89	.234	4
5	.22	.18194	.207	.204	.212	5.38	.219	5
6	.203	.16202	.192	.201	.192	4.88	.203	6
7	.18	.14428	.177	.199	.176	4.47	.188	7
8	.165	.12849	.162	.197	.16	4.06	.172	8
9	.148	.11443	.148	.194	.144	3 66	.156	9
10	.134	.10189	.135	.191	.128	3 26	.141	10
11	.12	.09074	.12	.188	.116	2.95	.125	11
12	.109	.08081	.105	.185	.104	2 64	.109	12
13	.095	.07196	.092	.182	.092	2 34	.094	13
14	.083	.06408	.08	.180	.08	2 03	.078	14
15	.072	.05707	.072	.178	.072	1.83	.07	15
16	.065	.05082	.063	.175	.064	1.63	.0625	16
17	.058	.04526	.054	.172	.056	1.42	.0563	17
18	.049	.0403	.047	.168	.048	1.22	.05	18
19	.042	.03589	.041	.164	.04	1.01	.0438	19
20	.035	.03196	.035	.161	.036	.91	.0375	20
21	.032	.02846	.032	.157	.032	.81	.0344	21
22	.028	.02535	.028	.155	.028	.71	.0313	22
23	.025	.02257	.025	.153	.024	.61	.0281	23
24	.022	.0201	.023	.151	.022	.56	.025	24
25	.02	.0179	.02	.148	.02	.51	.0219	25
26	.018	.01594	.018	.146	.018	.45	.0188	26
27	.016	.01419	.017	.143	.0164	.42	.0172	27
28	.014	.01264	.016	.139	.0148	.38	.0156	28
29	.013	.01126	.015	.134	.0136	.35	.0141	29
30	.012	.01002	.014	.127	.0124	.31	.0125	30
31	.01	.00893	.0135	.120	.0116	.29	.0109	31
32	.009	.00795	.013	.115	.0108	.27	.0101	32
33	.008	.00708	.011	.112	.01	.25	.0094	33
34	.007	.0063	.01	.110	.0092	.23	.0086	34
35	.005	.00561	.0095	.108	.0084	.21	.0078	35
36	.004	.005	.009	.106	.0076	.19	.007	36

EQUIVALENT VALUES OF ELECTRICAL, MECHANICAL, AND HEAT UNITS

Unit	Equivalent Value in Other Units
1 Kw-hour =	1,000 watthours 1.341 horsepower-hours 2,655.200 ft-lb 3,600.000 joules 3,415 BTU 367,100 kilogram-meters 0.234 lb carbon oxidized with perfect efficiency 3.52 lb water evap from and at 212 F 22.77 lb of water raised from 62 to 212 F
1 Hp-hour =	0.7457 kw-hour 1,980,000 ft-lb 2,546.5 BTU 273,740 kilogram-meters 0.174 lb carbon oxidized with perfect efficiency 2.62 lb water evap from and at 212 F 17.0 lb water raised from 62 F to 212 F
1 Kilowatt =	1,000 watts 1.3410 horsepower 2,655,200 ft-lb per hour 44,254 ft-lb per minute 737.56 ft-lb per second 3,415 BTU per hour 56.92 BTU per minute 0.9486 BTU per sec. 0.234 lb carbon oxidized per hour 3.52 lb water evap per hr from and at 212 F
1 Hp =	745.7 watts 0.7457 kw 33,000 ft-lb per minute 550 ft-lb per second 2,546.5 BTU per hour 42.44 BTU per minute 0.707 BTU per second 0.174 lb carbon oxidized per hour 2.62 lb water evap per hour from and at 212 F
1 Joule =	1 watt-second 0.000000278 kw-hour 0.10197 kilogram-meter 0.0009486 BTU 0.73756 ft-lb
1 Ft-lb =	1.3558 joules 1.13826 kilogram-meter 0.0000003766 kw-hour 0.0012861 BTU 0.0000005 hp-hour
1 Watt =	1 joule per second 0.001341 hp 3.415 BTU per hour 0.73756 ft-lb per second 0.0035 lb water evap per hour 44.254 ft-lb per minute
1 Watt per Sq In. =	8.20 BTU per sq ft per minute 6,373 ft-lb per sq ft per minute 0.1931 hp per sq ft
1 BTU =	1,054.2 watt-seconds 777.54 ft-lb 107.5 kilogram-meters 0.0002928 kw-hours 0.0003927 hp-hour 0.0000685 lb carbon oxidized 0.001030 lb water evap from and at 212 F
1 BTU per Sq. Ft per Min =	0.1220 watt per sq in 0.01757 kw per sq ft 0.02356 hp per sq ft
1 Kilogram-meter =	7.233 ft-lb 0.000003653 hp-hour 0.000002724 kw-hour 0.009302 BTU
1 lb Carbon Oxidized with Perfect Efficiency =	14,600 BTU 1.11 lb anthracite oxidized 2.5 dry wood oxidized 22 cu ft illuminating gas 4.75 kw-hour 5.733 hp-hour 11,352,000 ft-lb 15.05 lb of water evap from and at 212 F
1 Lb Water Evap from and at 212 F =	0.2841 kw-hour 0.3811 hp-hour 970.4 BTU 104,320 kilogram-meter 1,023,000 joules 754,525 ft-lb 0.066466 lb carbon oxidized

Physical Properties of Various Metals

Name of Substance	Physical Condition or Composition of Substance	Resistance in Ohms per Circ. Mil. Foot at 68° F.	Temperature Coefficient of Resistivity for One Degree F.	Specify Gravity	Approximate Maximum Working Temperature in Degrees F.	Approximate Melting Point in Degrees, F.
Copper	Annealed	10.4	0.00393	8.89	500	1980
Platinum	Pure	57.4	0.00204	21.5	2700	3190
German Silver	18%-Copper-Nickel-Zinc	200	0.000172	8.5	500	1880
German Silver	30%-Copper-Nickel-Zinc	290	0.000111	8.5		2120
Ia Ia Soft	Copper-Nickel	283	0.00000278	8.4	700	2250
Advance	Copper-Nickel	294	nil	8.9	700	2300
Constantin	Copper-Nickel	300	0.00000278	8.6		
Ideal	Copper-Nickel	300	0.00001	8.85	700	2200
Krupp	Nickel-Steel	511	0.00039	8.10	1100	
Superior	Nickel-Steel	517	0.00045	8.4	1000	2400
Climax	Nickel-Steel	525	0.0004	8.14	1000	2300
Phenix	Nickel-Steel	520	0.0003	8.09	1000	2100
Excello	Nickel-Chromium	550	0.00009	8.9	2000	3000
Nichrome	Nickel-Chromium	600	0.00024	8.15	2200	2800
Calido	Nickel-Chromium	600	0.00019		2000	2800
Nichrome II	Nickel-Chromium	655	0.00009	8.02	2000	2860
Calorite	Nickel-Chromium	720			1600	2370
Carbon	Retort	4325*	not constant	1.8	6000	6700
Graphite	Acheson	4875*	not constant	2.2	6000	6700
Carb. Filament	Treated	6950**	not constant		3500	6700

Table of Comparative Resistances

(MATTHIESSEN'S STANDARD)

COPPER 1.

Materials	Relative Resistance
Silver annealed	0.925
Copper	1.00
Gold (99% pure)	1.38
Aluminum (99% pure)	1.61
Zinc	3.62
Platinum, annealed	5.65
Iron	5.70
Nickel	7.78
Tin	8.28
Lead	12.8
Antimony	22.1
Mercury	59.3
Bismuth	82.2
Carbon (arc light)	2510.0

Conversion Factors, Converting Thermal and Mechanical Units to Electric Units and Vice Versa.

1 B.t.u.	=	0.2928 watt-hours
1 foot-lb.	=	0.001286 B.t.u.'s
1 foot-lb.	=	0.0003766 watt-hours
1 watt-hour	=	2,655 foot-pounds
1 watt-hour	=	3.415 B.t.u.'s
1 B. H. P.	=	9804. watts

Electrical Formula for Determining Amperes, Horse-Power, Kilowatts and Kilovolt-amperes

Desired Data	Alternating Current			Direct Current
	Single-Phase	Two-Phase* Four-Wire	Three-Phase	
Kilowatts	$\frac{1\times E\times P.F.}{1000}$	$\frac{1\times E\times 2\times P.F.}{1000}$	$\frac{1\times E\times 1.73\times P.F.}{1000}$	$\frac{1\times E}{1000}$
Kva.	$\frac{1\times E}{1000}$	$\frac{1\times E\times 2}{1000}$	$\frac{1\times E\times 1.73}{1000}$	
Horse-power Output	$\frac{1\times E\times \%Eff.\times P.F.}{746}$	$\frac{1\times E\times 2\times \%Eff.\times P.F.}{746}$	$\frac{1\times E\times 1.73\times \%Eff.\times P.F.}{746}$	$\frac{1\times E\times \%Eff.}{746}$
Amperes when Horse-power is Known	$\frac{H.P.\times 746}{E\times \%Eff.\times P.F.}$	$\frac{H.P.\times 746}{2\times E\times \%Eff.\times P.F.}$	$\frac{H.P.\times 746}{1.73\times E\times \%Eff.\times P.F.}$	$\frac{H.P.\times 746}{E\times \%Eff.}$
Amperes when Kilowatts is Known	$\frac{K.W.\times 1000}{E\times P.F.}$	$\frac{K.W.\times 1000}{2\times E\times P.F.}$	$\frac{K.W.\times 1000}{1.73\times E\times P.F.}$	$\frac{K.W.\times 1000}{E}$
Amperes when Kva. is Known	$\frac{KVA.\times 1000}{E}$	$\frac{KVA.\times 1000}{2\times E}$	$\frac{KVA.\times 1000}{1.73\times E}$	

*In three-wire, two phase circuits the current in the common conductor is 1.41 times that in either other conductor.
E = Volts. I = Amperes. %Eff. = Per Cent Efficiency. P.F. = Power Factor.

Time Intervals Within Which National Electrical Code Standard Enclosed Fuses Must Blow

Fuse Rating in Amperes	Maximum Blowing Time in Minutes	
	On 135 Per Cent Current	On 200 Per Cent Current*
0-30	60	2
31-60	60	4
61-100	120	6
101-200	120	8
201-400	120	10
401-600	120	12

* A 600-volt fuse rated at 100 amperes or less and plainly marked "For use only on motor circuits" may blow within eight minutes.

Fusing Currents of Commercial Fuse Wire

The values given below are approximate, since the fusing current is determined by the proportion and kinds of alloys used, kind and form of terminal, length of fuse, and on other factors.

Nearest Size Awg	Diameter, In.	Fusing Current, Amp	Nearest Size Awg	Diameter, In.	Fusing Curent, Amp
30	0.010	1.7	10	0.100	54.1
24	0.020	4.9	9	0.110	63.1
20	0.030	9.0	8	0.130	81.1
19	0.035	11.3	7	0.140	90.6
18	0.040	13.3	7	0.150	100.5
16	0.050	19.8	6	0.160	110.7
14	0.060	25.4	5	0.180	132.1
13	0.070	32.0	4	0.200	154.7
12	0.080	39.1			

Ohm's Law

The strength of the current in any circuit is directly proportional to the electromotive force in that circuit and inversely proportional to the resistance of that circuit, i.e., is equal to the quotient arising from dividing the electromotive force by the resistance.

Let E=electromotive force in volts
R=resistance in ohms
I=strength of current in amperes

Then $$I = \frac{E}{R}, R = \frac{E}{I}, E = IR$$

Example.—The electromotive force of a circuit is 110 volts, and its resistance is 55 ohms; what is the strength of current?

Solution — E= 110 volts. R = 55 ohms

$$I = \frac{E}{R} = \frac{110}{55} = 2 \text{ amperes}$$

The ohm, ampere, and volt are defined in terms of one another as follows: Ohm, the resistance of a conductor through which a current of 1 ampere will pass when the electromotive force is 1 volt. Ampere, the quantity of current which will flow through a resistance of 1 ohm when the electromotive force is 1 volt. Volt, the electromotive force required to cause 1 ampere to flow through a resistance of 1 ohm.

Motor Wiring

(Condensed from National Electrical Code 1940)

HP	Approx Full Load Amp	†† Min. Size Wire Awg or MCM Type R	*** Size Conduit in In.	** Rating of Branch Circuit Fuses	Full Load Amp	†† Min. Size Wire Awg or MCM Type R	Size Conduit in In.	** Rating of Branch Circuit Fuses
3-PHASE SQUIRREL-CAGE INDUCTION MOTORS								
	220 Volt				440 Volt			
1	3.3	14	½	* 15	1.7	14	½	* 15
1½	4.7	14	½	* 15	2.4	14	½	* 15
2	6	14	½	* 20	3.0	14	½	* 15
3	9	14	½	* 30	4.5	14	½	* 15
5	15	12	½	* 45	7.5	14	½	* 25
7½	22	8	1	* 70	11	14	½	* 35
10	27	8	1	* 80	14	12	½	* 45
15	38	5	1¼	*125	19	10	¾	* 60
20	52	3	1¼	*175	26	8	1	* 80
25	64	2	1½	*200	32	6	1¼	*100
30	77	0	2	*250	39	5	1¼	*125
40	101	000	2	‡250	51	3	1¼	‡125
50	125	0000	2½	‡350	63	2	1½	‡175
60	149	300	3	‡400	75	0	2	‡200
75	180	400	3	‡450	90	00	2	‡225
SINGLE-PHASE INDUCTION MOTORS								
	115 Volts				230 Volts			
½	6.7	14	½	20	3.4	14	½	15
¾	9	14	½	30	4.5	14	½	15
1	10.5	14	½	35	5.3	14	½	20
1½	14.5	12	½	45	7.3	14	½	25
2	19	10	¾	60	9.5	14	½	30
3	27	8	¾	80	13.5	12	½	40
5	...	...	...	....	22	8	¾	60
DIRECT-CURRENT MOTORS								
	115 Volts				230 Volts			
1	5.4	14	½	15	4.2	14	½	15
1½	12.5	12	½	20	6.3	14	½	15
2	16.1	10	¾	25	8.3	14	½	15
3	23	8	¾	35	12.3	12	½	20
5	40	5	1¼	60	19.8	10	¾	30
7½	58	2	1¼	90	28.7	6	1	45
10	75	0	1½	125	38	5	1¼	60
15	112	0000	2	175	56	2	1¼	90
20	140	250	2½	225	74	0	1½	125

* For Full-voltage starting of normal torque motors having Code letters F to R.

† For autotransformer starting of normal torque motors having Code letters F to R.

** The fuse rating may be as much as 400% of motor rated current to permit motor to start but should be kept as low as possible for best short-circuit protection. Additional protection of an approved type *must* be provided to protect each motor against normal operating overloads. Thermal air circuit breakers are also extensively used for branch-circuit protection. Ratings in general are somewhat lower than those listed for fuses.

*** Conduit size for 3-phase squirrel-cage induction motors refers to three conductors in one conduit. Conduit size for single-phase and direct-current motors refers to two conductors in one conduit.

†† The values given are for not more than three conductors in raceway or cable, and having rubber insulation, other than the so-called performance and heat-resisting types. In general, larger current values are permitted for the latter types and for single conductors in free air, for which see National Electrical Code. In order to avoid excessive voltage drop where long runs are involved, it may be necessary to use conductors and conduit of sizes larger than the minimum sizes listed above.

LINEAR MEASURE

12 inches=1 foot 3 feet=1 yard 5½ yards=1 rod
40 rods=1 furlong 8 furlongs=1 mile

EQUIVALENT VALUES

Inches	Feet	Yards	Rods	Furlongs	Miles
36 =	3 =	1			
198 =	16.5 =	5.5 =	1		
7,920 =	660 =	220 =	40 =	1	
63,360 =	5,280 =	1,760 =	320 =	8 =	1

SQUARE MEASURE

144 square inches = 1 square foot
9 square feet = 1 square yard
30¼ square yards = 1 square rod
160 square rods = 1 acre
640 acres = 1 square mile

EQUIVALENT VALUES

Square mile	Acres	Square rods	Square yards
1 =	640 =	102,400 =	3,097,600
Square mile	**Square feet**		**Square inches**
1 =	27,878,400 =		4,014,489,600

CUBIC MEASURE

1,728 cubic inches = 1 cubic foot
27 cubic feet = 1 cubic yard
128 cubic feet = 1 cord
24¾ cubic feet = 1 perch
1 cubic yard = 27 cubic feet = 46,656 cubic inches

WEIGHT—AVOIRDUPOIS

437½ grains = 1 ounce 16 ounces = 1 pound
100 pounds = 1 hundredweight
2,000 pounds = 1 ton 2,240 pounds = 1 long ton
1 ton = 20 cwt = 2,000 pounds = 32,000 ounces = 14,000,000 grains
1 pound avdp = 7,000 grains

WEIGHT—TROY

24 grains = 1 pennyweight 20 pennyweights = 1 ounce
12 ounces = 1 pound
1 pound = 12 ounces = 240 pennyweights = 5,760 grains

DRY MEASURE

2 pints = 1 quart 8 quarts = 1 peck 4 pecks = 1 bushel
1 bushel = 4 pecks = 32 quarts = 64 pints
U. S. bushel = 2,150.42 cu. in.
British = 2,218.19 cu. in.

LIQUID MEASURE

4 gills = 1 pint 4 quarts = 1 gallon
2 pints = 1 quart 31½ gallons = 1 barrel
63 gallons or 2 barrels = 1 hogshead
1 hogshead = 2 barrels = 63 gallons = 252 quarts = 504 pints = 2,016 gills
The U. S. gallon contains 231 cu. in. = 0.134 cu. ft.
1 cubic foot of water = 7.481 gallons and weighs 62.425 lb. at 39.2 F.
1 gallon of water weighs 8.45 lb.
(For ordinary work 1 cu. ft. is considered 7½ gal.; 1 gal. 8 1/3 lb.)

MEASURE OF ANGLES OR ARCS

60 seconds = 1 minute
60 minutes = 1 degree
90 degrees = 1 right angle or quadrant
360 degrees = 1 circle
1 circle = 360° = 21,600′ = 1,296,000″
1 minute of arc on the earth's surface = 1 nautical mile = 1.17 times a land mile or 6,080 feet.

MARINER'S MEASURE

6 feet = 1 fathom 5,280 feet = 1 statute mile
120 fathoms = 1 cable length
6,080 feet = 1 nautical mile
7 1/3 cable lengths = 1 mile

MISCELLANEOUS

3 inches = 1 palm
4 inches = 1 hand
9 inches = 1 span
12 articles = 1 dozen
12 dozen = 1 gross
12 gross = 1 great gross
2 articles = 1 pair
18 inches = 1 cubit
21.8 inches = 1 Bible cubit
2½ feet = 1 military pace
1 league = 3 miles
20 articles = 1 score
24 sheets = 1 quire
20 quires = 1 ream

TABLE OF MULTIPLIERS

Diameter of a circle × 3.1416 = Circumference.
Radius of a circle × 6.283185 = Circumference.
Square of the radius of a circle × 3.1416 = Area.
Square of the diameter of a circle × 0.7854 = Area.
Square of the circumference of a circle × 0.07958 = Area.
Half the circumference of a circle × half its diameter = Area.
Circumference of a circle × 0.159155 = Radius.
Square root of the area of a circle × 0.56419 = Radius.
Circumference of a circle × 0.31831 = Diameter.
Square root of the area of a circle × 1.12838 = Diameter.
Diameter of a circle × 0.866 = Side of an inscribed equilateral triangle.
Diameter of a circle × 0.7071 = Side of an inscribed square.
Circumference of a circle × 0.225 = Side of an inscribed square.
Circumference of a circle × 0.282 = Side of an equal square.
Diameter of a circle × 0.8862 = Side of an equal square.
Base of a triangle × half the altitude = Area.
Multiplying both diameters and .7854 together = Area of an ellipse.
Surface of a sphere × one-sixth of its diameter = Volume.
Circumference of a sphere × its diam. = Surface.
Square of the diameter of a sphere × 3.1416 = Surface.
Square of the circumference of a sphere × 0.3183 = Surface.
Cube of the diameter of a sphere × 0.5236 = Volume.
Cube of the circumference of a sphere × 0.016887 = Volume.
Radius of a sphere × 1.1547 = Side of an inscribed cube.
Area of its base × one-third of its altitude = Volume of a cone or pyramid, whether round, square, or triangular.
Area of one of its sides × 6 = Surface of a cube.
Altitude of trapezoid × one-half the sum of its parallel sides = Area.

RESUSCITATION FROM ELECTRICAL SHOCK

As Recommended by The National Electric Light Association

Follow These Instructions Even if Victim Appears Dead

I. Immediately Break the Circuit

With a single quick motion, free the victim from the current. Use any *dry non-conductor* (clothing, rope, board) to remove the victim or the wire. Beware of using metal or any moist material. While freeing the victim from the live conductor have every effort also made to shut off the current quickly.

II. Instantly Attend to the Victim's Breathing

As soon as the victim is clear of the conductor, rapidly feel with your finger in his mouth and throat and remove any foreign body (tobacco, false teeth). Then begin artificial respiration at once. Do not stop to loosen the victim's clothing now; every moment of delay is serious. Proceed as follows:

1. (a) Lay the patient on his belly, with arms extended as straight forward as possible and with face to one side, so that nose and mouth are free for breathing. Let an assistant draw forward the patient's tongue.

(b) Kneel straddling the patient's thighs, and facing his head; rest the palms of your hands on the loins (on the muscles of the small of the back), with fingers spread over the lowest ribs.

(c) With arms held straight, swing forward slowly so that the weight of your body is gradually *but not violently*, brought to bear upon the patient. This act should take from two to three seconds.

(d) Then immediately swing backward so as to remove the pressure, thus returning to the position described in (b).

(e) Repeat deliberately twelve to fifteen times a minute the swinging forward and back—a complete respiration in four or five seconds.

(f) As soon as this artificial respiration has been started, and while it is being continued, an assistant should loosen any tight clothing about the patient's neck, chest, or waist.

2. Continue the artificial respiration (if necessary, two hours or longer), *without interruption* until natural breathing is restored, or until a physician arrives. If natural breathing stops after being restored, use artificial respiration again.

3. *Do not give any liquid by mouth until the patient is fully conscious.*

4. Give the patient fresh air, but keep him warm.

III. Send for Nearest Doctor

INDEX

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SYCAMORE, ILLINOIS, U. S. A.

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